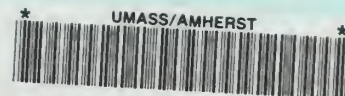


MASS. LRW1.2:L95/2/v.4 v



312066 0282 4462 2

DRAFT
FOR PUBLIC COMMENT

Low-Level Radioactive Waste
Management Plan

Volume IV

Appendices

GOVERNMENT DOCUMENTS
COLLECTION

SEP 10 1993

University of Massachusetts
Depository Copy



THE COMMONWEALTH OF MASSACHUSETTS
Low-Level Radioactive Waste Management Board
100 Cambridge Street, Room 903
Boston, MA 02202
(617)727-6018
FAX: (617)727-6084

DRAFT -- FOR PUBLIC COMMENT

Low-Level Radioactive Waste Management Plan

Volume IV Appendices

January 1993

**by Carol C. Amick
Executive Director**

Massachusetts Low-Level Radioactive Waste Management Board

**Susan Tierney
Secretary, Executive Office of Environmental Affairs**

**Charles D. Baker
Secretary, Executive Office of Health and Human Services**

**Susan C. Fargo
Chairman**

**Charles B. Killian
Vice Chairman**

Timothy W. Brennan

Barry Connell

John A. Mayer, Jr.

Judith A. Shope

Table of Contents

	Page
Chapter 111H. Massachusetts Low-Level Radioactive Waste Management Act	1-3
Chapter 549 of the Acts of 1987 Section 6	2-3
Public Law 96-573 December 22, 1980	3-3
Public Law 99-240 January 15, 1986	4-3
10 CFT Part 20 Nuclear Regulatory Commission Standards for Protection Against Radiation	5-3
10 CFR Part 61 Nuclear Regulatory Commission Licensing Requirements for Land Disposal of Radioactive Waste	6-3

Chapter 111H
Massachusetts Low-Level Radioactive Waste
Management Act

Chapter 111H. Massachusetts Low-Level Radioactive Waste Management Act

Section

1. Definitions.
2. Low-level radioactive waste management board; establishment; appointment of members.
3. Board members; term of office; board actions; meetings.
4. Powers and duties of board; acceptance of donations, loans or grants.
- 4A. Low Level Radioactive Waste Management Fund; assessments.
- 4B. Violations of section 4A; civil penalties.
5. Executive director; duties.
6. Public participation coordinator; duties.
7. Information concerning type, volume, radioactivity, source and characteristics of low-level radioactive waste; inspections; confidentiality.
8. Issuance of orders; notice and opportunity for hearing; civil penalties; injunctions and actions to compel.
9. Management of low-level radioactive waste; liability; damages; funds to satisfy liability.
10. Phase I of the Low-Level Radioactive Waste Management Act; planning.
11. Procedures for adoption of management plan.
12. Preparation, adoption by regulation, and implementation of management plan; contents of plan.
13. Low-level radioactive waste source minimization, volume minimization and storage for decay by generators program; establishment.
14. Site selection criteria and application guidelines; adoption of regulations.
15. Selection of operators; adoption of regulations.
16. Licensing, development, operation, closure, post-closure observation and maintenance, and institutional control of facilities; adoption of regulations.
17. Initiation of site selection process; board vote; conditions.
18. Phase II of the Low-Level Radioactive Waste Management Act; implementation for site selection process.
19. Site selection process; procedures.
20. Site selection process; issuance of required reports; public meetings; acquisition of property interest in candidate sites.
21. Community supervisory committees; establishment.
22. Requests for proposals for development, operation and closure of a facility; investigation and certification of applicants; contract.
23. Detailed site characterization plan for candidate sites; public review and comment; selection of superior site.
24. Petition by aggrieved person; adjudicatory proceeding.
25. Phase III of the Low-Level Waste Management Act; selection of operator and technology.
26. Community supervisory committee representatives, appointment; site community field offices, establishment.
27. Certified applicant interviews; selection of operator of superior site facility.
28. Execution of development contract.
29. Phase IV of the Low-Level Radioactive Waste Management Act; facility approval and licensing.
30. Notice of intent to apply for facility license; environmental impact report.
31. Facility license application; public comment period; preparation of draft license or draft denial; final decision.
32. [Blank].
33. Negotiation of comprehensive operating contract; contents.
34. Community compensation.
35. Phase V of the Low-Level Radioactive Waste Management Act; facility development, operation, and closure.
36. Comprehensive environmental monitoring program; establishment.
37. Commencement of facility construction.
38. Payment by operator equal to expected annual operating budget; proposed fees and waste acceptance criteria schedule.
39. Determination of operator's compliance with comprehensive operating contract; notice to generators.
40. Operation of facility; temporary or permanent closure; inspection report.
41. Contingent liability account; institutional control account.
42. Administration of the Low-Level Radioactive Waste Trust Fund.
43. Facility closure plan.
44. Active observation and maintenance of facility.
45. Phase VI of the Low-Level Radioactive Waste Management Act; institutional control of facility.
46. Transfer of facility license from operator.
47. Institutional control of facility; annual report; public meetings.
48. Statutes not applicable.

Chapter 111H was added by St.1987, c. 549, § 5.

§ 1. Definitions

As used in this chapter, the following words shall, unless the context clearly indicates otherwise, have the following meanings:—

“Affected community”, a community, other than a site community, which is identified in an environmental impact report prepared pursuant to section thirty, and can be expected to experience significant impacts as a result of the location, development, operation, closure, post-closure observation and maintenance or institutional control of a facility.

"Board", the low-level radioactive waste management board established in section two which shall be responsible for planning and effecting the management of low-level radioactive waste in the commonwealth in accordance with the provisions of this chapter.

"Broker", a person engaged in the business of arranging for the collection, transportation, treatment, storage or disposal of low-level radioactive waste.

"Candidate site", a site, identified in accordance with the procedures established in section twenty, which will be the subject of detailed site characterization as part of the process to select any superior site.

"Candidate site community", a community in which is located all or any part of a candidate site.

"Chief executive officer", the city manager in any city having a city manager, the mayor in any other city, the town manager in any town having a town manager, the chairman of the board of selectmen in any other town.

"Citizens advisory committee", the committee established pursuant to section thirty and the regulations adopted by the secretary of the executive office of environmental affairs to facilitate public participation in the evaluation and review of the environmental impacts of a facility prior to licensing.

"Closure", the permanent termination of low-level radioactive waste acceptance at a facility, including closure prior to the scheduled closing date, and the implementation of a closure plan.

"Closure plan", the plan, required as a condition of a facility license, prepared pursuant to regulations adopted under section sixteen, to assure safe facility closure after operation.

"Community", a city or town of the commonwealth.

"Community compensation", any money, thing of value or economic benefit conferred by an operator or the board on any site or neighboring community under the terms and conditions specified in a comprehensive operating contract executed pursuant to section thirty-three.

"Community supervisory committee", a committee, established pursuant to section twenty-one, to facilitate the participation of a community, in which a candidate site is located, in the activities established by this chapter.

"Comprehensive operating contract", a contract entered into by an operator and the board pursuant to section thirty-three which specifies the community compensation to be provided by the operator or the board.

"Contingent liability account", an account within the Low-Level Radioactive Waste Trust Fund established in section forty-one for the purpose of compensating for injuries to persons, land or property, pursuant to section nine, if no other funds, insurance, tort compensation or other means of satisfying a damage judgment or settlement are available.

"Detailed site characterization", the on-site investigatory and analytical step of site selection established in section twenty-three and conducted prior to the selection of any superior site.

"Development", all activities undertaken with respect to a low-level radioactive waste facility during the period commencing with the selection of any superior site pursuant to section twenty-three and continuing until the commencement of facility operation pursuant to section thirty-nine.

"Development contract", a contract entered into by an operator and the board pursuant to section twenty-eight under which such operator shall be obligated to fulfill all of the requirements of the facility approval process established pursuant to sections twenty-nine through thirty-four inclusive.

"Disposal", the isolation of low-level radioactive waste from the biosphere inhabited by human beings and their food chains.

"Environmental monitoring program", a monitor program established by the department of public health, after consultation with the department of environmental quality engineering and the board of health of each site community, pursuant to section thirty-six for the purpose of collecting and analyzing environmental data prior to construction and throughout the construction, operation, closure, post-closure observation and maintenance and institutional control of a facility.

"Facility", a parcel of land, together with the structures, equipment and improvements thereon or appurtenant thereto, which, pursuant to this chapter, is being developed, is used, or has been used for the treatment, storage or disposal of low-level radioactive waste; but does not include any property used for temporary storage of low-level radioactive waste in sealed containers by a broker.

"Facility license", a license to operate a facility issued by the department of public health pursuant to section thirty-one.

"Generator", a person, including a broker, who produces low-level radioactive waste.

"Half-life", the time in which half the atoms of a particular radioactive substance disintegrate to another nuclear form.

"Institutional control", the continued observation, monitoring, and care of a facility following transfer of the facility license from the operator to the board.

"Institutional control account", an account within the Low-Level Radioactive Waste Trust Fund established in section forty-one for the purpose of paying institutional control costs pursuant to sections nine and forty-seven.

"Low-level radioactive waste", radioactive material that (1) is neither high-level waste, nor spent nuclear fuel, nor by-product material as defined in section 11(e)(2) of the Atomic Energy Act of 1954, as amended, 42 USC Section 2014(e); and (2) is classified by the Federal Government as low-level radioactive waste, but not including waste which remains a federal responsibility, as designated in section 3(b) of the Low-Level Radioactive Waste Policy Act, as in effect as of the effective date of this chapter, as amended, 42 USC Section 2021c(b).

"Low-level Radioactive Waste Trust Fund", a trust fund established pursuant to section thirty-five II of chapter ten which shall consist of surcharges collected from users of the low-level radioactive waste facility in an amount determined by the board on an annual basis, which shall be used to meet the obligations set forth in sections nine and forty-seven.

"Management", the storage, packaging, treatment, transportation, or disposal, where applicable, of low-level radioactive waste.

"Management plan", the low-level radioactive waste management plan adopted by the board pursuant to section twelve to provide for the safe and efficient management of low-level radioactive waste.

"Neighboring community", a community, other than a site community, which, according to the most recent decennial census conducted pursuant to section seven of chapter nine, has at least twenty per cent of its population residing within three miles of any superior site.

"Operator", a person designated in accordance with the procedures established in sections twenty-two and twenty-seven to develop and operate a low-level radioactive waste facility.

"Operation", the control, supervision or implementation of the actual physical activities involved in the acceptance, storage, treatment, disposal or monitoring of low-level radioactive waste at a facility and the maintenance of the facility and any other responsibilities of operation pertaining to the facility.

"Person", any agency or political subdivision of the federal government or the commonwealth, or of any state, any public or private corporation or authority, individual, firm, joint stock company, partnership, association, trust, estate, institution or other entity, and any officer, employee or agent of such person, and any group of such persons.

"Possible location", a location, identified in accordance with the procedures established in section twenty, which will be the subject of preliminary characterization.

"Post-closure observation and maintenance", the active monitoring and maintenance of a facility which has been closed in preparation for transfer of the facility's license from the operator to the board.

"Preliminary characterization", the investigatory and analytical step established in section twenty, and conducted prior to the identification of candidate sites.

"Professional training", the level of academic or on-the-job training generally recognized as adequate to qualify a person to be employed in a discipline.

"Public meeting", a public hearing, satisfying the requirements of section two of chapter thirty A, in which an agency presents information, responds to inquiries and hears testimony of interested persons.

"Shallow land burial", a land disposal method that relies on the site's natural characteristics as the primary barrier for isolation of the waste.

"Site community", the community in which is located all or any part of any superior site.

"Source minimization", minimizing the volume of radioactivity of low-level radioactive waste prior to its generation by such methods as: (1) avoiding unnecessary contamination of items during the use of radioactive materials; (2) carefully segregating radioactive waste from non-radioactive trash; or (3) substituting non-radioactive isotopes or radioisotopes with shorter half-lives where practicable.

"Storage", the holding of low-level radioactive waste for treatment or disposal.

"Storage for decay", a procedure in which low-level radioactive waste with a relatively short half-life is held for natural radioactive decay in compliance with applicable federal and state regulations.

"Superior site", any site selected by the board, after detailed site characterization, pursuant to section twenty-three.

"Temporary closure", the nonpermanent termination of low-level waste acceptance at a facility prior to its scheduled closing date.

"Treatment", any method, technique, or process, including source minimization, volume minimization and storage for decay, designed to change the physical, radioactive, chemical or biological characteristics or composition of low-level radioactive waste in order to render such waste safer for management, amenable for recovery, convertible to another usable material or reduced in volume.

"Volume minimization", treatment of low-level radioactive waste after its generation in order to minimize the physical dimensions of the waste and the space required for disposal.

"Waste management area", that portion of a facility where low-level radioactive waste has been, is being or will be treated, stored or disposed of.

Added by St.1987, c. 549, § 5.

Historical and Statutory Notes

1987 Legislation

St.1987, c. 549, § 5, adding this chapter consisting of this section and §§ 2 to 48, was ap-

proved Dec. 8, 1987, and by § 10 made effective upon passage.

§ 2. Low-level radioactive waste management board; establishment; appointment of members

(a) There is hereby established as an independent agency within, but not subject to the control of, the executive office of environmental affairs, the low-level radioactive waste management board. The board shall be responsible for planning and effecting the management of low-level radioactive waste in the commonwealth in accordance with the provisions of this chapter.

(b) The board shall consist of nine members appointed by the governor, one of whom shall be the secretary of the executive office of environmental affairs and one of whom shall be the secretary of the executive office of human services or their designees; provided, however, that no such designee may be an employee of the department of public health or the department of environmental protection. The remaining members of the board will be appointed by the governor from lists of candidates whose experience, background and professional training indicates that they can act in the public interest as follows: one of whom shall have professional training and experience in public administration shall be appointed from lists of nominees submitted by organizations with statewide membership that have demonstrated an interest in public or municipal management; one of whom shall have professional training and experience in engineering shall be appointed from lists of nominees submitted by organizations with statewide membership that have demonstrated an interest in engineering; one of whom shall have professional training and experience in a radiological health field shall be appointed from lists of nominees submitted by organizations with statewide membership that have demonstrated an interest in radiological health; one of whom shall have professional training and experience in business management shall be appointed from lists of nominees submitted by organizations with statewide membership that have demonstrated an interest in business management; and three of whom shall have professional training and experience in environmental protection shall be appointed from lists of nominees submitted by environmental organizations with statewide membership that have demonstrated an interest in low-level radioactive waste management. The governor shall make the initial appointment of such membership by November thirtieth, nineteen hundred and eighty-seven and shall make subsequent appointments no more than sixty days after a vacancy occurs, but shall not appoint any particular member unless at least three nominations have been submitted by appropriate organizations; provided, however, that additional members shall be appointed to the board upon the selection of a superior site as follows: the chief executive officer of each site community in which is located a facility that is in development, operation, closure, post-closure observation and maintenance or institutional control pursuant to this chapter, shall appoint a community resident to serve as a member of the board; and provided, further, that if there is only one site community in the commonwealth, the chief executive officer of the neighboring community having the greatest population residing within three miles of the superior site, shall also appoint a community resident to serve as a member of the board, but, if no community is eligible for such appointment, the chief executive officer of the site community shall appoint a second community resident to serve as a member of the board.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, § 199; St.1991, c. 138, § 43.

Historical and Statutory Notes

1987 Legislation

Sections 6 and 7 of St.1987, c. 549, provide:

"Section 6. The low-level radioactive waste management board, established under the provisions of section two of chapter one hundred and eleven G of the General Laws, is hereby authorized and directed to represent the commonwealth in any and all negotiations with other states for the purpose of reaching an interstate compact agreement to provide for the establishment and operation of regional disposal facilities for low-level radioactive waste. In carrying out the duties established hereunder, said board may initiate negotiations with any state it deems appropriate to meet the needs of the commonwealth with respect to such facilities upon a majority vote of the board. The board shall include as part of its management plan adopted pursuant to section eleven of chapter one hundred and eleven H of the General Laws a detailed report which shall include a summary of

all negotiations conducted prior to the establishment of the board, a study of the feasibility of the commonwealth entering into a regional compact which shall identify those states the board deems appropriate for the commonwealth to negotiate with. After the issuance of the detailed report the board shall report semiannually to the joint committee on natural resources on its progress in its negotiations for a regional compact which shall include any additional states which the board determined it is appropriate to negotiate with or any other developments which impact on the establishment of an interstate compact, including any cost to the commonwealth for the disposal of low-level radioactive waste or the volume of waste to be stored in the commonwealth arising from the regional compact negotiations.

"Section 7. The governor, on behalf of the commonwealth, may enter into an agreement with the federal nuclear regulatory commission

under section 274 of the Atomic Energy Act of 1954, providing for discontinuance of the regulatory authority of the commission with respect to low-level radioactive waste, by-product, source, and special nuclear material, and the assumption by the commonwealth of the authority to regulate the materials covered by the agreement for the protection of the public health and safety from radiation hazards.

"Any person who, on the effective date of an agreement entered into pursuant to this section, possesses a license issued by the federal nuclear regulatory commission for radioactive materials subject to such agreement shall be deemed to possess a like license issued under section five N of chapter one hundred and eleven of the General Laws. Within ninety days of the effective date of such agreement, the department shall reissue such license on such forms as it may require by regulation; provided, however that such reissued license shall expire on the date of

expiration specified in the nuclear regulatory commission license."

1990 Legislation

St.1990, c. 177, § 199, an emergency act, approved Aug. 7, 1990, in par. (b), in the first sentence, substituted "protection" for "quality engineering".

1991 Legislation

St.1991, c. 138, § 43, approved July 10, 1991, and by § 393 made effective as of July 1, 1991, in par. (a), in the first sentence, substituted "as an independent agency within, but not subject to the control of, the executive office of environmental affairs" for "within the executive office for administration and finance".

The Governor's purported disapproval in part of St.1991, c. 138, § 43, was held invalid. See Opinion of the Justices (1991) 582 N.E.2d 504, 411 Mass. 1201.

§ 3. Board members; term of office; board actions; meetings

(a) Except as hereinafter provided, each member of the board shall serve for a term of seven years. Board members initially appointed shall serve as follows: the public administration member shall serve for a term of three years; provided, however, that the appointment of a public administration member to succeed the initial public administration member shall serve for a term of five years; of the three environmental protection members, one shall serve for a term of three years, one shall serve for a term of four years, and one shall serve for a term of five years; provided, however, that the appointment of an environmental protection member to succeed the environmental protection member appointed for a term of three years, shall serve for a term of six years; the engineering member shall serve for a term of six years; the business management member shall serve for a term of seven years; and provided further, that the term of each initial member appointed to the board shall expire on the first day of July in the year following the respective terms of appointment.

(b) Members appointed by the chief executive officer of a site or neighboring community shall serve at the pleasure of such chief executive officer, provided, however, that the terms of office of such members shall expire upon the decision of the board to terminate development of a facility at a superior site or upon termination of institutional control of the facility at the superior site pursuant to section forty-seven.

(c) Except as otherwise provided in this chapter, board actions shall require a majority vote of its members. A roll call vote shall be required upon request of any member. The governor shall appoint the initial board chairperson from among the members of the board who shall serve as chairperson until the first day of July next following such appointment. Thereafter, the board shall annually elect a chairperson from among its members. Board members not otherwise employed by the commonwealth shall each receive fifty dollars for each day or part thereof for their services, and all members shall be reimbursed by the commonwealth for all reasonable expenses actually and necessarily incurred in the performance of their official duties.

(d) The board shall meet at least monthly and shall also meet upon the call of the chairperson or a majority of its members. All meetings of the board shall be conducted in accordance with the provisions of section eleven A. and one-half of chapter thirty A.

Added by St.1987, c. 549, § 5.

§ 4. Powers and duties of board; acceptance of donations, loans or grants

(a) The board shall have the following powers and duties:

(1) to take any action authorized by this chapter either directly or through, or by means of, its own officers, agents or employees, or by contract with any person, including, but not limited to, the adoption of a management plan pursuant to section twelve; the adoption of regulations governing the selection of operators pursuant to section fifteen; the certification of any operator applicants, pursuant to section twenty-two, who satisfy the board's regulatory criteria; the selection of any superior site pursuant to section twenty-three; the execution of a comprehensive operating contract pursuant to section thirty-three; the approval of a schedule of fees and waste acceptance criteria submitted by any operator, pursuant to section thirty-eight; the administration of the Low-level Radioactive Waste Trust Fund established in section forty-one; and the acceptance of the transfer of any facility license from the operator at the commencement of institutional control of the facility pursuant to section forty-six;

(2) to adopt such regulations as are necessary to accomplish the purposes of this chapter, including regulations governing its procedures;

(3) to call to its assistance and avail itself of the services of such employees of any federal, state, county or municipal department, board, commission, or agency as may be required and made available;

(4) to adopt regulations governing its use of consultant services, and the use of consultant services by community supervisory committees established pursuant to this chapter, which shall establish the rate of compensation for such services; provide for the prior approval by the board, of any such services for which no rate has previously been established by regulation; and require, at a minimum, that any such consultant shall satisfy the standards of conduct provided in section twenty-three of chapter two hundred and sixty-eight A; provided, however, that, except as provided in this section, such regulations shall be consistent with the regulations of the commissioner of administration adopted pursuant to section twenty-nine A of chapter twenty-nine unless the board determines that an inconsistent regulation is necessary to accomplish the purposes of this chapter;

(5) to adopt regulations governing the provision of technical assistance and planning funds to enable community supervisory committees to be established and to participate in the activities established by this chapter;

(6) to conduct continuing public participation and informational programs in accordance with section six;

(7) subject to the provisions of this section, to accept, receive, utilize, and dispose, for any of its purposes and functions, any and all donations, loans, grants or reimbursements of money, equipment, supplies, materials, and services, conditional or otherwise, including any payments made pursuant to section 5(d) of the Low-Level Radioactive Waste Policy Act, as amended 42 USC section 2021e(d), from any state or the United States or agency or political subdivision thereof, or interstate agency, or from any person;

(8) to acquire, by purchase or eminent domain, through the division of capital planning and operations, such interests in land as are necessary to conduct site selection activities pursuant to sections twenty and twenty-three or develop a facility at any superior site selected pursuant to said section twenty-three;

(9) to issue annually, no later than November thirtieth, a report of its activities, which shall be transmitted to the clerk of the senate, the clerk of the house of representatives, the governor, and the chief executive officer of each site, neighboring and affected community, and shall include:

(A) a list of the time, location and subjects of all meetings and adjudicatory proceedings conducted during the year and the minutes thereof;

(B) a list and description of regulations adopted during the year;

(C) a description of all activities undertaken pursuant to sections eighteen to twenty-three, inclusive, during the year;

(D) the most recent management plan adopted by the board; and

(E) a list of any reports prepared during the year; and

(10) to prepare and submit to the commissioner of administration an estimate, required to be filed under section three of chapter twenty-nine, of the amount required for the maintenance of the board, including any costs of providing funds to community supervisory committees pursuant to section twenty-one.

(b) The board shall establish regulations for the acceptance of donations, loans, grants of money, equipment, supplies, materials, and services. The nature, amount and conditions, if any, attendant upon any donation, loan, or grant accepted pursuant to this section, together with the identity of the donor, grantor, or lender, shall be made public. No donor, lender, or grantor shall derive any advantage in any proceeding before the board by reason of such donation, loan or grant.

Added by St.1987, c. 549, § 5.

§ 4A. Low Level Radioactive Waste Management Fund; assessments

(a) There is hereby established on the books of the commonwealth a separate fund, to be known as the Low Level Radioactive Waste Management Fund. For the purpose of providing funds to implement the management plan adopted pursuant to section twelve and to carry out the powers and duties conferred by this chapter, the board shall annually assess each person licensed or registered to receive, possess, use, transfer or acquire radioactive materials in the commonwealth, amounts sufficient to defray the costs annually incurred by the board for such purposes. Amounts assessed shall be deposited in said fund and may be expended by the board, subject to appropriation, to carry out the powers and duties conferred by this chapter. The total amount to be assessed shall be apportioned annually in accordance with a schedule, sufficient to produce an amount not to exceed five hundred thousand dollars, adopted by regulation by the board, after notice to interested persons and a public hearing. In establishing such schedule, the board shall reduce the total amount to be assessed by the amount of any other donations, loans, grants, reimbursements, payments or unexpended assessments received, or other funds appropriated to implement the management plan and to carry out the powers and duties conferred by this chapter. Such schedule shall be based on the volume and classification of radioactivity of waste produced by each licensee and registrant which is shipped for disposal off site or stored for later disposal; provided, however, that the board shall make a minimum assessment on all licensees and registrants. Such schedule may further provide for surcharges based on the classification scheme contained in the management plan. Assessments shall be due and payable not less than ninety days after written notice to the person upon whom such assessment is imposed, and shall accrue interest at twelve percent per annum on and after the due date. Failure without just cause to pay any lawful assessment pursuant to this section shall constitute a violation of this section.

(b) The board may, subject to appropriation and by an equitable method established by regulation, refund to persons who have paid an assessment pursuant to this section, the amount by which the assessments, interests and penalties collected in the prior fiscal year pursuant to this section and section four B exceeds the amounts expended by the board, including fringe benefits, for the purposes specified in this section.

(c) The board shall, on or before July first of each year, submit to the governor and the house and senate committees on ways and means, an annual report of the assessments, interest and penalties collected pursuant to this section and section four B for the previous fiscal year. Said annual report shall include a statement of disbursements for that fiscal year from said fund, and any other information the board deems appropriate.

(d) Nothing in this section shall be construed to relieve the board of its duty, pursuant to section four, to prepare and submit to the secretary of administration and finance an estimate of the amount required for the maintenance of the board, or of its duty, pursuant to section nine E of chapter twenty-nine, to notify said secretary and the house and senate committees on ways and means if the appropriation for the implementation of the management plan and to carry out the powers and duties conferred by this chapter will be insufficient to meet all of the expenditures required in the current fiscal year and of the estimated amount of such additional requirements.

(e) No assessment shall be due and payable pursuant to this section after June thirtieth, nineteen hundred and ninety-three, unless the board has submitted the schedule of assessments it has adopted to the house and senate committees on ways and means at least ninety days prior to sending any notice of such assessment pursuant to this section.

Added by St.1991, c. 138, § 166.

Historical and Statutory Notes

1991 Legislation

St.1991, c. 138, § 166, was approved July 10, 1991, and by § 393 made effective as of July 1, 1991.

§ 4B. Violations of section 4A; civil penalties

(a) If the board finds, after notice of any violation of section four A and an opportunity for a hearing have been provided, that any person is not in compliance with any requirement of section four A, or with any provision of any regulation adopted thereunder, it may assess civil penalties in an amount determined pursuant to this section. Such civil penalty may be imposed whether or not the violation was willful. In determining the amount of the civil penalty, the board shall consider the willfulness of the violation; the actual and potential cost to the commonwealth of collecting the assessment and penalty to enforce such requirement; whether the person being assessed the civil penalty did everything reasonable to pay the assessment, and to pay promptly after a notice of violation was issued; whether the person being assessed the civil penalty has previously failed to comply with any requirement of section four A, or with any provision of any regulation adopted thereunder; the financial condition of the person being assessed the civil penalty. The board shall also consider the goals of making compliance less costly than noncompliance, deterring future noncompliance, and the public interest.

(b) In addition to assessing civil penalties under this section, the board may request the attorney general to bring an action in the superior court to compel payment of assessments and penalties and immediate and full compliance with any order issued by the board. The expense of the proceedings shall be recoverable from the violator in such manner as provided by law.

Added by St.1991, c. 138, § 166.

Historical and Statutory Notes

1991 Legislation

St.1991, c. 138, § 166, was approved July 10, 1991, and by § 393 made effective as of July 1, 1991.

§ 5. Executive director; duties

The board, after an open and competitive selection process, shall appoint a full-time executive director based on demonstrated competence. The executive director shall serve at the pleasure of the board and may appoint, discharge, contract for, compensate, or otherwise provide for such additional staff and consultants, as he determines necessary to carry out the board's duties and functions; provided, however, that the appointment of principal staff must be approved by a majority vote of the board. The executive director shall be the chief administrative officer of the board. Except where a vote of the board is required by this chapter, the board may delegate to the executive director full authority to carry out its duties and functions, subject to such conditions and instructions as the board may deem appropriate.

Added by St.1987, c. 549, § 5.

§ 6. Public participation coordinator; duties

The executive director, after an open and competitive selection process, shall appoint a full-time public participation coordinator based on demonstrated competence subject to

approval by a vote of the board. The public participation coordinator's duties shall include:

(a) to encourage and facilitate the participation of interested persons in all of the processes established in or pursuant to this chapter;

(b) to make recommendations to the board, the department of public health and the department of environmental protection concerning the implementation of programs to assure appropriate public participation in the processes established in or pursuant to this chapter;

(c) to publicize throughout the commonwealth the management plan adopted pursuant to section twelve, all plans for the selection of any superior site or for the selection of an operator, and any proposals for the development, operation and closure of facilities in order to inform the public and to encourage and facilitate the participation of interested persons in such selection procedures, in environmental review and licensing proceedings, and in the review of facility operations; and

(d) to publicize throughout the commonwealth and to conduct continuing public informational programs on the use of radioactive materials, the nature and characteristics of low-level radioactive waste, current and developing technologies, and the hazards associated with low-level radioactive waste and the improper management thereof; provided, however, that, in establishing and conducting such programs, the public participation coordinator shall obtain the advice and assistance of an advisory board to be composed of members representing the range of public opinion concerning low-level radioactive waste or its management and invite the participation of persons representing such range of public opinion.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, § 200.

Historical and Statutory Notes

1990 Legislation

St.1990, c. 177, § 200, an emergency act, approved Aug. 7, 1990, in cl. (b), substituted "protection" for "quality engineering".

§ 7. Information concerning type, volume, radioactivity, source and characteristics of low-level radioactive waste; inspections; confidentiality

(a) For the purpose of ensuring the accuracy and completeness of the low-level radioactive waste management plan or of determining compliance with this chapter or any regulations adopted hereunder, each person who generates, treats, stores, transports or disposes of low-level radioactive waste within the commonwealth shall annually, and at such other times as requested by the department of public health, provide detailed and accurate information concerning the type, volume, radioactivity, source and characteristics of the low-level radioactive waste which such person generates, treats, stores, transports or disposes of; as well as such person's current and projected low-level radioactive waste management activities, including source minimization, volume minimization, on-site storage, treatment, packaging and transportation practices and such other information as the board or the department of public health deems necessary. The duly authorized inspectors of said department may, at all reasonable times, enter and examine any property, facility, or activity involving the management of low-level radioactive waste. The owner, operator and other person in charge of the property, facility, or activity, shall afford such inspectors unfettered access, equivalent to access provided to persons regularly employed at such property, facility or activity, following proper identification and compliance with applicable access control measures for security, radiological protection and personal safety. Such inspectors are authorized to make such inspections, conduct such tests, reviews, studies, monitoring, or sampling or examine books, papers and records as said department deems necessary for the administration or enforcement of this chapter.

(b) Notwithstanding the provisions of any general or special law to the contrary, any information, record or particular part thereof, obtained by the department of public health

pursuant to the provisions of this chapter, shall, upon request by the owner or proprietor thereof, be kept confidential and not be considered to be a public record when it is determined by said department that such information, record, or report, relates to secret processes or methods of manufacture or production, or that such information, record or report, if made public, would divulge a trade secret. Nothing in this section shall prevent use of such information in the preparation of the management plan, or of any summary or statistical compilation of information obtained by said department.

(c) All procurement activities and all payments made under contracts entered into pursuant to this chapter including any development contract and any comprehensive operating contract, shall be deemed to be within the jurisdiction of the office of the inspector general in accordance with chapter twelve A.

Added by St.1987, c. 549, § 5.

§ 8. Issuance of orders; notice and opportunity for hearing; civil penalties; injunctions and actions to compel

(a) The department of public health may issue orders as are reasonably necessary for the enforcement of the provisions of this chapter. Such orders may include, but not be limited to orders modifying, suspending, or revoking licenses and orders requiring persons to cease any activity that is in violation of the provisions of this chapter or of any regulation adopted or facility license issued hereunder. Such orders shall be issued after notice and an opportunity for hearing except where public health, safety or the environment would be threatened by delay in the issuance of such order. In such circumstance, an opportunity for hearing shall be provided promptly after issuance of such order.

(b) If the department of public health finds, after notice and an opportunity for a hearing has been provided, that any person is not in compliance with any order issued pursuant to this section, or with any provision of this chapter or any regulation adopted hereunder, it may assess civil penalties in an amount not exceeding one hundred thousand dollars for each such violation. Such civil penalty may be assessed whether or not the violation was willful. In determining the amount of the civil penalty, the said department shall consider the willfulness of the violation; the actual and potential danger or injury to the public health or the environment; the actual and potential cost of such damage or injury; the actual and potential cost to the commonwealth of enforcing the provisions of this chapter; whether the person being assessed the civil penalty did everything reasonable to prevent the failure to comply from occurring, and to promptly come into compliance, and to remedy and mitigate whatever harm might have been done as a result of the failure to comply; whether the person being assessed the civil penalty has previously failed to comply with any order issued pursuant to this section, or with any provision of this chapter or any regulation adopted hereunder; making compliance less costly than noncompliance; deterring future noncompliance; the financial condition of the person being assessed the civil penalty; and the public interest.

(c) In addition to assessing civil penalties under this section, the department of public health may request the attorney general to bring an action in the superior court to restrain, prevent or enjoin any conduct prohibited by this chapter and to compel action to comply immediately and fully with any order issued by the department. The expense of the proceedings shall be recoverable from the violator in such manner as provided by law.

(d) It shall be unlawful for any person to willfully:

(1) violate or assist in the violation of any of the provisions of this chapter or of any regulations adopted hereunder;

(2) fail to comply with any order issued by the department of public health pursuant to this section;

(3) attempt to obtain a license by misrepresentation or failure to disclose all relevant facts.

(e) Any person convicted of unlawful conduct as defined in this section shall, for each offense, pay a fine of not less than one thousand nor more than twenty thousand dollars; or be imprisoned for a period of not more than twenty years; or both. Each day of

continued violation of any provision of this chapter or of any regulation adopted or order issued hereunder shall constitute a separate offense.

Added by St.1987, c. 549, § 5.

§ 9. Management of low-level radioactive waste; liability; damages; funds to satisfy liability

(a) It shall be the responsibility of the operator to take all appropriate steps to clean up and stabilize the facility and to contain migration of low-level radioactive waste or associated toxic materials, whenever there has been or impends a release of such materials at the facility during its operation, closure or post-closure observation and maintenance. The board shall ensure that the operator has sufficient funds to satisfy this responsibility. The board shall have such responsibility during the period of institutional control and shall utilize sums from the institutional control account within the Low-Level Radioactive Waste Trust Fund established pursuant to section forty-one to satisfy this responsibility. If all other sources of funds, including federal assistance, have been exhausted, the commonwealth shall provide the reasonable costs of clean-up and stabilization of a facility.

(b) Except as otherwise provided in this section, any person who carries on any activity involving the management of low-level radioactive waste shall be subject to strict liability for harm to persons, land or property resulting from such activity when caused by any release of, or exposure to, such waste or associated toxic materials. Such liability may be joint and several unless such person establishes by a preponderance of the evidence that only a portion of such harm has resulted from such activity. No claim for such harm may be made against the operator after a facility's license has been transferred to the board pursuant to section forty-six, unless the operator has willfully misrepresented the conditions of the facility at the time of such transfer or fraudulently concealed information about the facility or its operations.

(c) Notwithstanding the provisions of this section, the board, community supervisory committees, the department of public health, the department of environmental protection and the deputy commissioner of the division of capital planning and operations shall be subject to liability for harm to persons, land or property resulting from the management of low-level radioactive waste only in accordance with the provisions of chapter two hundred and fifty-eight; provided, however, that the amount of damages for which liability may be imposed shall not be subject to the limit provided in section two of said chapter two hundred and fifty-eight. Notwithstanding any limitation contained in said chapter two hundred and fifty-eight, but in accordance with the procedures established therein, the board shall be subject to liability for harm to persons, land or property which may occur after the board assumes its responsibility for institutional control of the facility pursuant to section forty-six, or from the negligence of any employee of the board in the institutional control of the facility.

(d) The board shall ensure that the operator has sufficient funds to satisfy its liabilities under this section, and for the compensation of injured facility employees. The board shall utilize sums from the institutional control account established in section forty-one to ensure the availability of funds to satisfy its liabilities under this section for which claims are made during the period of institutional control; provided, however, that the funds available to satisfy such liabilities from third party claims shall be at least equal to the maximum amount available from the nuclear insurance pools or other commercial insurers.

(e) If no other funds, insurance, tort compensation or other means of satisfying a damage judgment or settlement, approved by a court of competent jurisdiction, are available, the contingent liability account established in section forty-one shall be utilized to compensate for injuries to persons or property resulting from the management of low-level radioactive waste or the institutional control of a facility.

(f) The commonwealth shall provide compensation for harm to persons, land or property which may occur after the board assumes its responsibility for institutional control of

17 M.G.L.A.—7
1992 P.P.

the facility pursuant to section forty-six, only, if all other sources of funds, including federal assistance, have been exhausted.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, § 201.

Historical and Statutory Notes

1990 Legislation

St.1990, c. 177, § 201, an emergency act, approved Aug. 7, 1990, in par. (c), in the first

sentence, substituted "protection" for "quality engineering".

Cross References

Proceeds from Low-Level Radioactive Waste Trust Fund, see c. 10, § 35I.

§ 10. Phase I of the Low-Level Radioactive Waste Management Act; planning

Planning for low-level radioactive waste management shall be conducted, subject to appropriation, in accordance with sections eleven to seventeen, inclusive, which shall be known and cited as "Phase I of the Low-Level Radioactive Waste Management Act". The provisions of such sections shall be implemented so as to require appropriate source minimization, volume minimization and storage for decay; to require a comprehensive management plan, an appropriate determination of need, and adequate regulatory controls and site selection criteria prior to the initiation of site selection; and to prohibit shallow land burial.

Added by St.1987, c. 549, § 5.

§ 11. Procedures for adoption of management plan

(a) The adoption of a management plan under section twelve the adoption of regulations for source minimization, volume minimization and storage for decay under section thirteen, the adoption of regulations for the selection of any superior site under section fourteen the adoption of regulations for operator selection under section fifteen and the adoption of regulations for the licensing of any facility under section sixteen shall be in accordance with the procedures set forth in this section. The recommendations of the public participation coordinator, made pursuant to section six, shall be implemented to the extent feasible in order to ensure appropriate public participation during the development of such plans and regulations; to ensure that adequate information concerning such plans and regulations is available; to facilitate the conduct of public meetings and other opportunities for public review and comment; and to ensure that public concerns are identified and addressed throughout the development of such plans and regulations.

(b) No fewer than four months prior to the initial adoption of a management plan pursuant to section twelve and the initial adoption of regulations under section thirteen to sixteen, inclusive, the responsible agencies shall issue drafts of such management plan and regulations, together with summaries thereof, for public review and comment. No fewer than thirty days and no more than ninety days after the issuance of such drafts, the responsible agencies and the public participation coordinator shall jointly conduct a minimum of six consolidated public meetings throughout the commonwealth on the drafts and shall accept written comments thereon. Such consolidated public meetings shall be conducted at times and locations to be agreed by the responsible agencies and the public participation coordinator.

(c) The management plan and any regulations adopted under any of sections thirteen to sixteen, inclusive, shall be adopted in accordance with the requirements of sections two to six, inclusive, of chapter thirty A; provided, however, that a public hearing satisfying the requirements of section two of said chapter thirty A shall be required prior to the adoption, amendment or repeal of the management plan or any such regulation.

(d) The initial management plan developed under section twelve and the initial regulations developed under sections thirteen to sixteen, inclusive, shall be adopted by January first, nineteen hundred and eighty-nine.

Added by St.1987, c. 549, § 5.

§ 12. Preparation, adoption by regulation, and implementation of management plan; contents of plan

(a) The board shall prepare, adopt by regulation, and implement a management plan to provide for the safe and efficient management of low-level radioactive waste. The primary consideration guiding the development of the management plan shall be the protection of public health, safety and the environment. The management plan shall be reviewed annually and revised as necessary.

(b) The management plan shall include, but not be limited to:

(1) a classification system, compatible with federal requirements and the regulations adopted by the department of public health under section sixteen, for all low-level radioactive waste generated, treated or disposed of in the commonwealth, based primarily on its radiological toxicity and radioactive half-life and also on the principal radionuclides present in the waste and their concentrations; its specific radioactivity; its chemical and biological toxicity and form; its chemical reactivity; its volume and such other characteristics as the board deems necessary to determine which classes of low-level radioactive waste may be stored for decay, which classes of low-level radioactive waste will require disposal and which classes will require special management procedures in order to facilitate the safe and timely closure, post-closure observation and maintenance and institutional control of the facility accepting such low-level radioactive waste;

(2) a review and analysis of current and developing low-level radioactive waste management technologies and practices, including their potential public health, safety and environmental impacts; their cost-effectiveness; their climatic, geologic, hydrogeologic, or other requirements; and their suitability for the low-level radioactive waste managed within the commonwealth; and any recommendations for regulatory or other actions to improve the safety or efficiency of such technologies and practices, and to ensure that the value of property in the vicinity of any facility is maintained;

(3) an inventory of all generators located in the commonwealth or whose low-level radioactive waste is to be accepted for treatment, storage or disposal within the commonwealth, including information on their location, products, services, clinical procedures, and teaching or research activities and an evaluation of the economic benefit to the commonwealth of such products, services and activities; the volume, characteristics and curies of their current and projected generation of low-level radioactive waste in compliance with any regulations adopted by the department of public health pursuant to section thirteen; and their current and projected low-level radioactive waste management activities including source minimization, volume minimization, on-site storage, treatment, packaging and transportation practices;

(4) an inventory of all facilities within or outside the commonwealth under development or available to accept low-level radioactive waste generated within the commonwealth, including information on their location, size and capacity, and on the volume, characteristics and curies of the low-level radioactive waste accepted or to be accepted at such facilities; and projections of the anticipated future capacity and availability of such facilities to meet future needs;

(5) a finding as to whether there is a requirement for additional facility capacity to meet present low-level radioactive waste management needs or needs anticipated to arise within the next decade, a specification of the volumes and classifications of low-level radioactive waste to be accepted during operation of such a facility and the minimum land area requirement of such a facility, and a statement of the factual basis of such finding and specification;

(6) a review and analysis of proposals for, and the utilization of, all low-level radioactive waste transportation routes, practices, regulations and emergency response and enforcement capabilities employed within the commonwealth;

(7) a report of all facilities in operation, temporary closure, closure, post-closure observation and maintenance or institutional control including the results of the most recent financial audit of each facility conducted by the state auditor pursuant to section thirty-eight; an analysis of fees being collected by the operator to demonstrate the financial integrity of its operation; the expected availability of sufficient funds to carry out facility closure and post-closure observation and maintenance; the expected adequacy of the contingent liability account and institutional control account within the Low-level Radioactive Waste Trust Fund established in section forty-one; based on the annual report of the environmental monitoring program, issued pursuant to section thirty-six; a summary of procedures used to monitor each facility, the principal findings made concerning the facility and a detailed account of any release at the facility of radioactive or toxic materials into the workplace or the environment, including the measures taken to contain or remedy such release; and the facility closure plan prepared pursuant to regulations adopted under section sixteen;

(8) a review and analysis of the adequacy of available insurance protection for low-level radioactive waste management activities against personal injury and property damage, including third-party liability insurance;

(9) a review and analysis of the effectiveness and feasibility of, and the development of recommendations for, encouraging or requiring minimization of the volume, radioactivity, toxicity, or other characteristics of low-level radioactive waste; and

(10) interim and emergency storage plans to go into effect whenever it appears that no facility is or will be available to accept low-level radioactive waste generated within the commonwealth. Such plans may include contractual agreements with facilities located outside the commonwealth. Notwithstanding any provision of section sixteen, if such plans include the development of an interim or emergency storage facility, the board or its designee may apply for a facility license in accordance with the provisions of section thirty-one and, upon its issuance, may construct and operate a facility to accept low-level radioactive waste for interim or emergency storage; provided, however, that no such facility may be constructed unless the department of public health has determined that the environmental monitoring program required in section thirty-six has yielded representative baseline data; and provided, further, that the board shall specify in its interim and emergency storage plans the maximum length of time during which such a facility may be utilized.

Added by St.1987, c. 549, § 5. Amended by St.1988, c. 199, § 22.

Historical and Statutory Notes

1987 Legislation

Section 8 of St.1987, c. 549, provides:

"Nothing in this act shall prohibit the department of public health from issuing a renewal license to any person lawfully holding a license to accept waste for treatment, storage or disposal as of the effective date of this act and any such person may apply to said department for an amendment of the terms and conditions of such license if the application for such amendment has been determined by the low-level radioactive

waste management board to be consistent with the management plan adopted pursuant to section twelve of chapter one hundred and eleven H of the General Laws."

1988 Legislation

St.1988, c. 199, § 22, an emergency act, approved July 26, 1988, in cl. (1) of par. (b), substituted "toxicity and radioactive half-life" for "toxicity an radioactive half-life", and deleted "which" following "classes of low-level radioactive waste".

§ 13. Low-level radioactive waste source minimization, volume minimization and storage for decay by generators program; establishment

The department of public health, after consultation with the board, shall establish a program for low-level radioactive waste source minimization, volume minimization and storage for decay by generators. Said department shall adopt regulations necessary to

implement such program consistent with the protection of public health, safety and the environment and with the promotion of responsible research and innovation. Such regulations shall require generators to avoid unnecessary contamination of items during the use of radioactive materials; to segregate radioactive waste from non-radioactive trash; and to prepare and implement plans for the utilization of all appropriate source minimization, volume minimization and storage for decay methods.

Added by St.1987, c. 549, § 5.

§ 14. Site selection criteria and application guidelines; adoption of regulations

(a) The department of environmental protection shall adopt regulations establishing criteria for the selection of any superior site, guidelines for their application, procedures for the conduct of site selection and plans for the creation within said department of a statewide resource center for the continued collection of data pertaining to site selection. Such regulations shall, at a minimum, be compatible with the federal regulatory program established pursuant to the Atomic Energy Act, 42 USC section 2071 et seq. The primary consideration in adopting such regulations shall be the protection of public health, safety and the environment.

(b) The site selection criteria and application guidelines shall ensure, at a minimum, that any superior site satisfies the following site suitability requirements.

(1) sites shall be capable of being characterized, modeled, and monitored;

(2) sites shall be well drained and free of areas of flooding or frequent ponding, waste management areas shall be outside any one-hundred-year flood plain, coastal high-hazard area, or wetland;

(3) upstream drainage areas shall be minimized to decrease the amount of run-off which could erode or inundate the waste management area;

(4) sites shall provide sufficient depth to the water table so that groundwater intrusion, perennial or otherwise, into the waste will not occur;

(5) the hydrogeologic unit used for waste management shall not discharge groundwater to the surface within the site;

(6) waste management area shall be located so that tectonic processes in the vicinity, such as faulting, folding, seismic activity or volcanism, will not occur which will significantly effect the ability of the site to meet any performance objectives adopted by the department of public health under section sixteen, or preclude adequate modeling and prediction of long-term impacts;

(7) waste management area shall be located so that surface geologic processes in the vicinity, such as mass wasting, erosion, slumping, landsliding, or weathering will not occur which will significantly affect the ability of the site to meet any performance objectives adopted by the department of public health under section sixteen, or preclude adequate modeling and prediction of long-term impacts;

(8) waste management areas shall be located so that nearby activities will not adversely affect the ability of the site to meet any performance objectives adopted by the department of public health under section sixteen, or significantly impair the environmental monitoring program;

(9) sites shall be located in areas with no known economically recoverable resources which, if exploited, would adversely affect the ability of the site to meet any performance objectives adopted by the department of public health under section sixteen, or significantly impair the environmental monitoring program;

(10) sites shall be located outside of, and so as not to adversely affect, the recharge zones of existing or future drinking water source aquifers;

(11) sites shall have sufficient land available to provide for the waste volume and a reasonable buffer around the waste management area;

(12) sites shall be located so as not to adversely affect any national park, monument, lake shore, habitat of endangered species, or area protected by the Wilderness Act, 16 USC sections 1131-1136, the Wild and Scenic Rivers Act, 16 USC sections 1271-1287, and the Fish and Wildlife Coordination Act, 16 USC sections 661-666C; or the National Historic Preservation Act, 16 USC sections 470-470m; and

(13) sites shall be located away from any structure or area in which are regularly found persons who, because of their age or physical characteristics, are likely to be at significantly higher than normal risk of adverse health effects if exposed to the release of radioactive or associated toxic materials.

(c) The procedures for the conduct of site selection shall include a quality assurance program designed to ensure data reliability, validity, traceability, and retrievability, as well as completeness and technical adequacy, for use in making any site selection decisions or subsequent licensing determination.

(d) The application of the site selection criteria adopted pursuant to this section shall not be subject to waiver by the department of environmental protection or the board.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, §§ 202, 203.

Historical and Statutory Notes

1990 Legislation

St.1990, c. 177, § 202, an emergency act, approved Aug. 7, 1990, in par. (a), in the first sentence, substituted "protection" for "quality engineering".

Section 203 of St.1990, c. 177, in par. (d), substituted "protection" for "quality engineering".

§ 15. Selection of operators; adoption of regulations

The board shall adopt regulations governing the selection of operators. Such regulations shall include financial, technical and management criteria and shall establish procedures adequate to determine that the operator possesses sufficient reliability, expertise, and competence to operate a facility so as to protect public health and the environment. Such determination shall be based, in part, on information submitted by applicants, in response to any request for proposals issued pursuant to section twenty-two, including:

(a) organizational information for the applicant and any proposed subcontractors detailing their legal structure, ownership and control and operational experience, and the background and qualifications of all officers, directors, partners and principal owners of each such firm and of the key personnel to be utilized in the performance of any contract with the board, and a description of the locations and operating experiences of existing or former operations of such persons; the history of compliance with, and any violations of federal, state or local requirements by such persons in any jurisdiction in which they or any of them have done business, and any felony convictions of such persons;

(b) a financial disclosure statement describing the applicant's financial resources and proposed revenue plans and demonstrating that the applicant either possesses the necessary funds or has reasonable assurance of obtaining the necessary funds to cover the estimated costs of development and operation of a facility and will have sufficient funds available to carry out facility closure and post-closure observation and maintenance; and

(c) a preliminary facility development, operation, closure, post-closure observation and maintenance and institutional control plan including a description of the proposed technology or technologies to be utilized, and of the applicant's staffing plans and personnel training program, safety and recordkeeping procedures, and emergency response plans.

Added by St.1987, c. 549, § 5. Amended by St.1988, c. 199, § 23.

Historical and Statutory Notes

1988 Legislation

St.1988, c. 199, § 23, an emergency act, approved July 26, 1988, in cl. (b), substituted "proposed" for "propose".

§ 16. Licensing, development, operation, closure, post-closure observation and maintenance, and institutional control of facilities; adoption of regulations

(a) The department of public health shall adopt regulations for the licensing, development, operation, closure, post-closure observation and maintenance, and institutional control of facilities in accordance with the procedure established in this section. Such regulations shall, at a minimum, be compatible with the federal regulatory program established pursuant to the Atomic Energy Act, 42 USC section 2071 et seq., and shall include procedures for license application and for setting a license decision schedule pursuant to section thirty-one; environmental and human exposure performance objectives, financial assurances and licensing requirements for facility construction; facility opening; low-level radioactive waste acceptance and inspection, storage, treatment and disposal; site maintenance; site safety, environmental monitoring and radiation and contamination control; facility security, recordkeeping and reporting; and quality control and training support; provided, however, that any disposal method utilized at a facility shall permit retrieval and monitoring of the waste, and provided further that shallow land burial shall be prohibited. Regulations governing low-level radioactive waste which is also hazardous waste as defined in section two of chapter twenty-one C, shall require an equivalent level of environmental protection as that required by said chapter and such regulations adopted thereunder; provided, however, that no low-level radioactive waste facility licensed pursuant to this chapter shall be subject to the provisions of chapter twenty-one D. Such regulations shall further require the operator to prepare, maintain and update a facility closure plan throughout the period of facility development and operation.

(b) The department of public health shall not issue a license pursuant to any regulation adopted under this section, authorizing any person to dispose of low-level radioactive waste or to accept waste from any other person for treatment or storage, unless the person making application for such license had been designated as an operator in accordance with the procedures established pursuant to sections twenty-two and twenty-seven. The department of public health shall not issue a license pursuant to any regulation adopted under this section unless the applicant had obtained all other permits and licenses required by law in order to commence construction of a facility; provided, however, that no community may prohibit, or require any license, permit, approval or condition for the construction, operation, closure, post-closure observation and maintenance or institutional control of a facility.

(c) Together with any draft regulations to be adopted under this section, which are issued for public review and comment, the department of public health shall issue a statement of any major alternative regulatory approaches and performance objectives considered but not proposed, and the reasons for the approach chosen and a description of: (1) the significant public health, environmental, social and economic impact of current low-level radioactive waste management practices and regulatory programs; (2) such impacts as are likely to result from the adoption of said department's proposal and from major alternative regulatory approaches considered by said department; and (3) such impacts as are likely to result from improper packaging, transportation incidents, improper design or operation of a facility, natural disaster, or inadvertent or purposeful intrusion into the facility.

Added by St.1987, c. 549, § 5.

§ 17. Initiation of site selection process; board vote; conditions

(a) The board shall initiate the site selection process established in sections eighteen to twenty-three, inclusive, if it determines, by a two-thirds vote of its members, that it is necessary and appropriate to proceed with site selection. Such vote may be taken only if:

(1) the board has adopted a low-level radioactive waste management plan under section twelve, incorporating a finding that there is a requirement for additional facility capacity to meet present needs or needs anticipated to arise within the next decade;

(2) the department of public health has adopted regulations under section thirteen necessary to implement a program for source minimization, volume minimization and storage for decay by generators;

(3) the department of environmental protection has adopted, under section fourteen, criteria for selection of any superior site for the development and operation of a low-level radioactive waste management facility, guidelines for their application, and procedures for implementing the site selection process;

(4) the board has adopted regulations, under section fifteen, for the selection of operators; and

(5) the department of public health has adopted regulations, under section sixteen, for the licensing development, operation, closure, post-closure observation and maintenance and institutional control of a facility.

(b) No fewer than twenty-one days prior to a vote to initiate site selection pursuant to this section, the board shall issue a notice, satisfying the requirements of section two of chapter thirty A, of its intent to conduct such vote.

(c) Upon voting to initiate site selection, the board shall notify the chief executive officer of each community of the commencement of the site selection process, explaining in detail the site selection criteria, guidelines for their application and procedures for implementation of site selection, and offering the resources of the board and the public participation coordinator to assist communities in participating in the site selection process.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, § 204.

Historical and Statutory Notes

1990 Legislation

St.1990, c. 177, § 204, an emergency act, approved Aug. 7, 1990, in par. (a), in cl. (3), substituted "protection" for "quality engineering".

§ 18. Phase II of the Low-Level Radioactive Waste Management Act; implementation for site selection process

The selection of any superior site shall be conducted in accordance with sections nineteen to twenty-four, inclusive, which shall be known and may be cited as "Phase II of the Low-Level Radioactive Waste Management Act," and in accordance with the regulations adopted under section fourteen. The provisions of such sections and regulations shall be implemented so as to ensure an open and fair process for selecting a superior site for any facility determined to be needed pursuant to Phase I of the Low-Level Radioactive Waste Management Act and for certifying applicants who satisfy the regulatory criteria adopted pursuant to said Phase I.

Added by St.1987, c. 549, § 5.

§ 19. Site selection process; procedures

(a) The site selection process conducted pursuant to sections twenty and twenty-three shall be in accordance with the procedures set forth in this section. The recommendations of the public participation coordinator, made pursuant to section six, shall be implemented to the extent feasible in order to ensure appropriate public participation in the site selection process; to ensure that adequate information concerning the site selection process is available; to facilitate the conduct of public meetings and other opportunities for public review and comment; and to ensure that public concerns are identified and addressed throughout the site selection process.

(b) In accordance with the regulations adopted under section four, the board shall retain such consultants as it determines are necessary to complete the site selection process.

(c) Each notice required by section twenty or twenty-three to be given to the chief executive officer of a community shall, at a minimum, explain in detail all actions taken pursuant to sections eleven to seventeen, inclusive, and those actions completed pursuant to section twenty or twenty-three, as well as the remaining actions to be undertaken pursuant to section twenty, twenty-three or twenty-four, and offer the resources of the board and the public participation coordinator to assist communities in participation in the site selection process.

Added by St.1987, c. 549, § 5.

§ 20. Site selection process; issuance of required reports; public meetings; acquisition of property interest in candidate sites

(a) The board shall issue a statewide mapping and screening report using existing data and analysis collected by the statewide resource center established pursuant to section fourteen or obtained by the board as of the date of its vote to initiate site selection. Such report shall identify, and exclude from further consideration in the site selection process, those areas of the commonwealth that are obviously unable to satisfy the site selection criteria adopted by the department of environmental protection under said section fourteen.

(b) After the issuance of the statewide mapping and screening report, the board shall issue a report identifying possible locations, which are likely to contain one or more candidate sites. The report shall describe the procedures used to identify such possible locations and establish that such procedures conform to the requirements of the regulations adopted by the department of environmental protection under section fourteen. Such possible locations shall include all available lands in the commonwealth which, on the basis of such information as is obtained by the board through its own investigations, appear to satisfy the site selection criteria adopted under said section fourteen. The board shall publicize the availability of such report for public review and comment, and shall provide a notice, satisfying the requirements of section nineteen to the chief executive officer of each community in which is located a possible location identified in the report. Within forty-five days of the issuance of such report, the board shall conduct at least one public meeting on the report in the vicinity of each possible location identified in the report at times and locations to be determined after consultation with the public participation coordinator and shall accept written comments thereon. The board shall consider and evaluate all comments and statements made at a public meeting or submitted in writing.

(c) Within ten months of the board vote, pursuant to section seventeen, to initiate the site selection process, the board shall issue a draft candidate site identification report. Such report shall identify at least two, but not more than five, candidate sites which the board considers best able to satisfy the site selection criteria adopted by the department of environmental protection under section fourteen, potentially licensable, capable of being developed, and otherwise appropriate for detailed site characterization pursuant to section twenty-three. Such report shall also include:

(1) a report of the results of a preliminary characterization of the meteorology, surface and groundwater, geology, tectonics, geomechanics, air quality, ecology, land use, cultural resources and social and economic characteristics of each such possible location;

(2) a description of the procedures used to identify the candidate sites based on such preliminary characterization; and

(3) draft plans for detailed site characterization of each candidate site pursuant to section twenty-three.

(d) The preliminary characterization required pursuant to this section shall be conducted, to the extent feasible, so as not to interfere with the quiet enjoyment of private property; provided, however, that, whenever the board deems it necessary to make

surveys, soundings, drillings or examinations to obtain information for, or to expedite the preliminary characterization, its authorized agents or employees may, after due notice by registered or certified mail, enter upon any lands, waters and premises, not including buildings, in the commonwealth for the purposes of making surveys, soundings, drillings and examinations as the board may deem necessary or convenient; and such entry shall not be deemed a trespass. The board shall make reimbursement for any injury or actual damage resulting to such lands, water and premises caused by any act of its authorized agents or employees, and the board shall, so far as possible, restore such lands to the same condition as prior to the making of such surveys, soundings, drillings or examinations.

(e) Upon the issuance of the draft candidate site identification report, the board shall transmit a copy of the draft report to the secretary of the executive office of environmental affairs; and widely publicize its availability for public review and comment; and the board and the deputy commissioner of the division of capital planning and operation shall jointly provide a notice satisfying the requirements of section nineteen of this chapter and section forty I of chapter seven, to all persons entitled under said section forty I of chapter seven to receive such notices and to the chief executive officer of each community in which is located all or part of a candidate site identified in such draft report. The board shall request each such chief executive officer to take appropriate action to establish a community supervisory committee for such community in accordance with section twenty-one.

(f) No person owning property identified in the draft candidate site identification report shall take any action or cause to have any action taken with respect to such property prior to the acceptance or amendment of such report by the board pursuant to this section which has the effect of interfering with or rendering more difficult or expensive the conduct of detailed site characterization of the property or the acquisition of a property interest therein pursuant to this section or section twenty-four.

(g) Within sixty days of the issuance of the draft report, the board shall conduct at least one public meeting on the report in each community in which is located all or part of a candidate site identified in the draft report, at times to be determined after consultation with the public participation coordinator. Such public meeting shall be deemed to satisfy the public hearing requirements of section forty I of chapter seven. The board shall accept written comments on the report submitted within sixty days of the public notice of its availability. Prior to its acceptance of the draft report, the board shall consider and evaluate all comments and statements made at a public meeting or submitted in writing.

(h) Upon receipt of the draft report, the secretary of the executive office of environmental affairs shall implement the public review and comment procedures established pursuant to section sixty-two C of chapter thirty; provided, however, that the review period established in such section shall not extend beyond the final date for acceptance of written comments by the board pursuant to this section. Within sixty days of the issuance of the draft report, said secretary shall issue a statement evaluating its technical adequacy and conformance with the regulations adopted under section fourteen. The said secretary shall transmit a copy of such statement to the board.

(i) No less than seventy-five days and no more than ninety days after the issuance of the draft report, the board shall conduct a vote to determine whether to accept the report and to proceed with detailed site characterization of the candidate sites identified therein, or amend the report and proceed with detailed site characterization of the candidate site identified in the report as amended. Such a vote shall be based on the technical adequacy of the report and its conformance with the regulations adopted under section fourteen. If the board fails to accept or amend the report, the report shall be set aside and the procedures established in this section shall be repeated; provided, however, that the board shall issue its revised draft report within four months of the expiration of the time for it to accept or amend the previous candidate site identification report.

(j) Upon the board's vote to proceed with detailed site characterization, the deputy commissioner of the division of capital planning and operations shall, on behalf of the board, take appropriate action to acquire, by purchase or taking, pursuant to chapter seventy-nine, a determinable property interest in each candidate site identified in the

candidate site identification report as accepted or amended by the board, or, in the case of real property of the commonwealth, to transfer the control and use of such property to the board. Acquisition or transfer of each such property interest shall be subject to the requirements of sections forty E to forty M, inclusive, of chapter seven; provided, however, that each candidate site shall be deemed to possess unique qualities for the purpose of section forty II of chapter seven. Such property interest shall be adequate to permit the conduct of detailed site characterization of the property, and to restrict the right to develop the property until a facility license is issued, pursuant to section thirty-one, to operate a facility at one of the candidate sites identified in the candidate site identification report as accepted or modified by the board.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, §§ 205 to 207.

Historical and Statutory Notes

1990 Legislation

St.1990, c. 177, § 205, an emergency act, approved Aug. 7, 1990, in par. (a), in the second sentence, substituted "protection" for "quality engineering".

Section 206 of St.1990, c. 177, in par. (b), in the second sentence, substituted "protection" for "quality engineering".

Section 207 of St.1990, c. 177, in par. (c), in the second sentence, substituted "protection" for "quality engineering".

§ 21. Community supervisory committees; establishment

(a) Upon issuance of the draft candidate site identification report, the board shall request the chief executive officer of each community in which is located all or part of a candidate site identified in such draft report to take appropriate action to establish a community supervisory committee for such community. Each community supervisory committee shall be composed of the chief executive officer or his designee, who shall serve as chairperson; the chairperson of the conservation commission or his designee; the chairperson of the board of health or his designee; the chairperson of the planning board or his designee; and three residents of the community nominated by the chief executive officer and approved by a majority vote of the city council or board of selectmen, who shall serve at the pleasure of the chief executive officer.

(b) If the chief executive officer of such community fails to take appropriate action to establish a community supervisory committee within forty-five days of the issuance of the draft candidate site identification report, the board shall designate a committee to assume the responsibilities of the community supervisory committee for such community until such community supervisory committee is established.

(c) The powers and duties of each community supervisory committee shall be:

(1) upon the designation of candidate sites pursuant to section twenty, to represent the best interests of the candidate site community in the site selection process established pursuant to sections twenty, twenty-three and twenty-four;

(2) upon selection of any superior site located within the community, to represent the best interests of the site community in the environmental review of, and licensing proceedings for the facility to be developed at such superior site and in the review and monitoring of facility operations; and

(3) to designate an operator and technology pursuant to section twenty-seven; and

(4) to receive and expend such technical assistance and planning funds as may be provided pursuant to this section.

(d) The board shall, in accordance with the regulations adopted under section four, provide sufficient funds to each community supervisory committee to enable it to acquire administrative and clerical personnel and to retain consultants necessary to exercise the powers and duties established in this section.

(e) Upon the expiration of thirty days after the selection of any superior site or, if a petition for an adjudicatory proceeding has been filed pursuant to section twenty-four,

upon a final decision of the commissioner of the department of environmental protection approving the site selection, no further funds shall be provided, pursuant to this section, to community supervisory committees in communities other than a site community. Upon the execution of a comprehensive operating contract pursuant to section thirty-three, no further funds shall be provided to community supervisory committees in site communities pursuant to this section.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, § 208.

Historical and Statutory Notes

1990 Legislation

St.1990, c. 177, § 208, an emergency act, approved Aug. 7, 1990, in par. (e), in the first

sentence, substituted "protection" for "quality engineering".

§ 22. Requests for proposals for development, operation and closure of a facility; investigation and certification of applicants; contract

(a) Within sixty days of a vote, pursuant to section seventeen, to initiate site selection, and after consultation with the deputy commissioner of the division of capital planning and operations the board shall issue a request for proposals for the development, operation, closure and post-closure observation and maintenance of a facility. The request for proposals shall conform to the regulations adopted under section fifteen, and shall include the most recent management plan adopted by the board under section twelve and a statement of procedures to be followed in responding to the request for proposals. The request for proposals shall require responses to be submitted by applicants within one hundred twenty days after its issuance. Each applicant shall be required to specify the terms under which it will participate in an advisory board that will assist in the planning and implementation of detailed site characterization pursuant to section twenty-four, and pay the board a fee of not less than ten thousand dollars at the time it submits its response to the request for proposals. Such fee shall be refunded only if the board fails to select a superior site, pursuant to section twenty-three, from among the candidate sites identified pursuant to section twenty.

(b) Within sixty days of the final date for submission of responses to the request for proposals, the attorney general shall prepare an investigative report to the board and the community supervisory committees, on each applicant and its officers, directors, partners, principal owners, key personnel and proposed subcontractors, describing their record of compliance with environmental and related laws, regulations, permits and licenses. Each applicant shall annually by March first, submit to the state ethics commission and the inspector general, a report listing each expenditure made during the previous calendar year by an official, employee or representative of the firm, including consultants or subcontractors, to or for the benefit of an official, employee, or representative, including consultants, of the board, the department of public health, the department of environmental protection, the division of capital planning and operations or any community supervisory committee. An officer of the firm shall certify the report as complete and accurate under pains and penalties of perjury. The state ethics commission, upon finding that there has been a violation of the reporting requirement set forth in this section, may issue an order requiring the violator to pay a civil penalty of not more than one thousand dollars for each day of violation and may file a civil action in superior court to enforce such order.

(c) Upon the issuance of the draft candidate site identification report pursuant to section twenty, and after consultation with the deputy commissioner of the division of capital planning and operations, the board shall certify those applicants who satisfy the financial, technical and management criteria adopted under section fifteen. Such certification shall be accompanied by a report including a justification for the certifications made. Such report shall be distributed to each community supervisory committee, the applicants and all others making a timely request. No applicant who fails to be certified pursuant to this section shall be required to submit a report to the state ethics commission and the inspector general, in accordance with this section, for any year after the year during which the certification of applicants is made.

(d) Within ninety days of the issuance of the draft candidate site identification report pursuant to section twenty, the board shall execute a contract with each certified applicant under which the applicant shall participate in an advisory board that will assist in the planning and implementation of detailed site characterization of the candidate sites identified pursuant to said section twenty.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, § 209.

Historical and Statutory Notes

1990 Legislation

St.1990, c. 177, § 209, an emergency act, approved Aug. 7, 1990, in par. (b), in the second

sentence, substituted "protection" for "quality engineering".

§ 23. Detailed site characterization plan for candidate sites; public review and comment; selection of superior site

(a) Each community supervisory committee shall assist the board in developing a detailed site characterization plan for a candidate site located within the community and participate throughout the implementation of such detailed site characterization plan. Appropriate board officials and consultants shall meet monthly with each community supervisory committee. Each community supervisory committee shall be kept informed of the progress of the detailed site characterization; be furnished copies of all data, reports and memoranda pertaining to said detailed site characterization including raw data, draft reports and memoranda; and given reasonable opportunity to review and comment upon all work performed.

(b) Within thirty days of the acceptance of the candidate site identification report pursuant to section twenty, the board and the community supervisory committee shall jointly conduct a public meeting in each candidate site community to discuss the draft plan for the detailed site characterization of the candidate site located within such community. The detailed site characterization plan adopted by the board shall include investigations and tests, both in the field and in the laboratory, which shall be conducted so as to demonstrate whether the site complies with the site selection criteria adopted under section fourteen; to provide information necessary for licensing of any facility at the site pursuant to section thirty-one, including an evaluation of the ability of the site characteristics to contribute to isolation of waste, data necessary for the proposed design of such a facility, an identification of potential interactions between the site characteristics and any low-level radioactive waste or waste containers located at the site to establish data collection points and baseline data suitable for use in an environmental monitoring program adopted pursuant to section thirty-six; and to identify, for inclusion in any environmental impact report prepared pursuant to section thirty, potential environmental impacts resulting from the development, operation, closure, post-closure observation and maintenance or institutional control of a facility at the site. Prior to its adoption of the final plan, the board shall consider and evaluate all comments made at a public meeting or in writing.

(c) Within one year and two months of the acceptance of the candidate site identification report pursuant to section twenty, the board shall issue a draft report of the detailed site characterization of each candidate site, and shall transmit a copy of such report to the secretary of the executive office of environmental affairs and the community supervisory committee. The draft report shall describe the procedures used to characterize each candidate site and establish that such procedures fully conform to the requirements of the regulations adopted under section fourteen.

(d) Upon issuance of the draft detailed site characterization report, the board shall widely publicize its availability for public review and comment, and the deputy commissioner of the division of capital planning and operations shall issue a notice, satisfying the requirements of section forty I of chapter seven, to all persons entitled thereby to review such notice. Within sixty days of the issuance of such report, the board shall conduct at least one public meeting on the report, in each candidate site community, at times to be determined after consultation with the public participation coordinator. Such public

meeting shall be deemed to satisfy the public hearing requirements of section forty I of chapter seven. The board shall accept written comments on the report submitted by the community supervisory committee or any other interested person within sixty days of the public notice of its availability.

(e) Upon receipt of the draft detailed site characterization report, the secretary of the executive office of environmental affairs shall implement the public review and comment procedures established pursuant to section sixty-two C of chapter thirty; provided, however, that the review period established in such section shall not extend beyond the final date for acceptance of written comments by the board pursuant to this section. Within seventy-five days of the issuance of the report, said secretary shall issue a statement evaluating its technical adequacy and conformance with the regulations adopted under section fourteen. The said secretary shall transmit a copy of such statement to the board and the community supervisory committee.

(f) No sooner than seventy-five days and no later than ninety days after the issuance of the draft detailed site characterization report, the board shall conduct a vote to determine whether to accept or amend the report. Such a vote shall be based on the technical adequacy of the report and its conformance with the regulations adopted pursuant to section fourteen. Prior to its acceptance of the report, the board shall consider and evaluate all comments made at a public meeting or submitted in writing. If the board fails to accept or amend the detailed site characterization report, the report shall be set aside, and the procedures established in this section shall be repeated; provided, however, that the board shall meet with each community supervisory committee to discuss the draft plan for implementing the revised detailed site characterization within thirty days of the expiration of the time for the board to accept or modify the detailed site characterization report; and provided, further, that the board shall issue its revised detailed site characterization report within one year and two months of the expiration date of the time for the board to accept or amend the prior detailed site characterization report.

(g) Upon voting to accept or modify a detailed site characterization report, the board may select any superior site by a two-thirds vote of its members. Upon such vote, the deputy commissioner of the division of capital planning and operations shall, on behalf of the board, take appropriate action to acquire, by purchase or taking, pursuant to chapter seventy-nine, a fee simple interest in the superior site, together with such other land, easements, rights-of-way or other property interests necessary to construct and operate a facility thereon and to conduct an environmental monitoring program pursuant to section thirty-six, or, in the case of real property of the commonwealth, to transfer the control and use of such property to the board. Such acquisition or transfer shall be subject to the requirements of sections forty E to forty M, inclusive, of chapter seven; provided, however, that the superior site shall be deemed to possess unique qualities for the purposes of section forty H of said chapter seven. Upon the acquisition of such interest, each site community, during the period prior to the issuance of a facility license, shall be entitled to receive an amount in lieu of local property taxes in accordance with section seventeen of chapter fifty-eight. No facility developed at a superior site selected pursuant to this section shall be subject to the department of environmental protection site assignment pursuant to section one hundred and fifty B of chapter one hundred and eleven.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, § 210.

Historical and Statutory Notes

1990 Legislation

St.1990, c. 177, § 210, an emergency act, approved Aug. 7, 1990, in par. (g), in the fifth

sentence, substituted "protection" for "quality engineering".

§ 24. Petition by aggrieved person; adjudicatory proceeding

(a) Upon petition by any person aggrieved by an action taken pursuant to sections nineteen, twenty, or twenty-three, made within thirty days after selection of a superior site pursuant to section twenty-three, the commissioner of the department of environmen-

tal protection shall commence an adjudicatory proceeding concerning the selection of the site. Such adjudicatory proceeding shall commence within sixty days of the filing of said petition and shall be conducted in compliance with the requirements of section eleven of chapter thirty A.

(b) In addition to the petitioner, the board and the site and neighboring communities shall be parties to the adjudicatory proceeding. Other aggrieved persons may intervene in accordance with the provisions of chapter thirty A.

(c) Within thirty days after the close of the adjudicatory proceeding, the commissioner of said department shall issue a final decision approving or disapproving the selection of the superior site. The site selection shall be approved if said commissioner finds, based on substantial evidence presented during the adjudicatory proceeding, that the site satisfies the site selection criteria adopted under section fourteen.

(d) The reasonable expenses of participation in the adjudicatory proceeding by site and neighboring communities, including attorney's fees, shall be reimbursed by the board in accordance with an order, specifying the amount and time for reimbursement, issued by the commissioner of the department of environmental protection at the time of the final decision.

(e) Any person aggrieved by a decision of said commissioner pursuant to this section may seek judicial review thereof in the supreme judicial court in accordance with the standards provided for judicial review in section fourteen of chapter thirty A.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, §§ 211, 212.

Historical and Statutory Notes

1990 Legislation

St.1990, c. 177, § 211, an emergency act, approved Aug. 7, 1990, in par. (a), in the first sentence, substituted "protection" for "quality engineering".

Section 212 of St.1990, c. 177, in par. (d), substituted "protection" for "quality engineering".

§ 25. Phase III of the Low-Level Waste Management Act; selection of operator and technology

The selection of an operator and technology or technologies to be utilized at a facility to be developed at any superior site shall be, conducted in accordance with sections twenty-six to twenty-eight, inclusive, which shall be known and be cited as "Phase III of the Low-Level Waste Management Act", and in accordance with the regulations adopted under section fifteen. The provision of said sections twenty-six to twenty-eight, inclusive, and regulations shall be implemented so as to permit any site community to select the operator and technology or technologies that best ensure proper facility operation in order to protect public health, safety and the environment.

Added by St.1987, c. 549, § 5.

§ 26. Community supervisory committee representatives, appointment; site community field offices, establishment

(a) Upon the expiration of thirty days after the selection of any superior site or, if a petition for an adjudicatory proceeding has been filed pursuant to section twenty-four, upon a final decision of the commissioner of the department of environmental protection approving the site selection, the board shall request the chief executive officer of each neighboring community to appoint a representative to the community supervisory committee of each site community. If the chief executive officer of a neighboring community fails to take such action within twenty-one days of receiving such request, the board shall make the appointment.

(b) Within sixty days of the selection of any superior site or, if a petition for an adjudicatory proceeding has been filed pursuant to section twenty-four, within thirty days of a final decision of the commissioner of the department of environmental protection

approving the site selection, the board shall establish a field office within a site community outside the boundaries of the superior site.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, §§ 213, 214.

Historical and Statutory Notes

1990 Legislation

St.1990, c. 177, § 213, an emergency act, approved Aug. 7, 1990, in par. (a), in the first sentence, substituted "protection" for "quality engineering".

Section 214 of St.1990, c. 177, in par. (b), substituted "protection" for "quality engineering".

§ 27. Certified applicant interviews; selection of operator of superior site facility

(a) No sooner than eleven months and no more than one year and two months after the acceptance of the candidate site identification report pursuant to section twenty, the community supervisory committee of each candidate site community shall interview those certified applicants who indicate their willingness to develop and operate a facility at a candidate site located within such community, and shall meet with the board or the deputy commissioner of the division of capital planning and operations at the request of any of them to discuss any aspects of the certified applicants qualifications or responses to the request for proposals.

(b) Each certified applicant interview shall be given an opportunity to submit to the community supervisory committee of the site community a written response to any question or requests made of such applicant, including a description of any necessary changes in the development, operation, closure, post-closure observation and maintenance and institutional control plans proposed to be implemented at the superior site and such other information that will allow the community supervisory committee to determine whether the applicant will be able to ensure proper facility operation in order to protect public health, safety and the environment and to serve the site and neighboring communities' interests, including any covenants proposed to be made by the applicant concerning transportation routing; access road construction; limitations on the hours or number of daily deliveries of low-level radioactive waste to the facility; the number of facility employees to be hired from among site, affected and neighboring community residents; and the amount of business to be contracted for with site, affected and neighboring community firms. Such written responses shall be submitted within sixty days of the selection of such superior site pursuant to section twenty-three.

(c) No fewer than sixty days and no more than ninety days after the selection of any superior site pursuant to section twenty-three, the community supervisory committee of the site community shall select, from among the certified applicants interviewed, the operator of the facility to be developed at such site; provided, however, that, if the candidate site is situated in more than one community, such selection shall be made by a majority vote of the members of the combined community supervisory committees of the site communities.

(d) If the community supervisory committee or committees fail to select an operator from among the certified applicants in accordance with this section, the board shall select such operator by a vote of its members.

(e) The selection of an operator pursuant to this section shall not be subject to the requirement of section forty-four A of chapter one hundred forty-nine.

(f) No certified applicant who fails to be selected as an operator pursuant to this section shall be required to submit a report to the state ethics commission and the inspector general, in accordance with section twenty-two, for any year after the year during which the operator is selected.

Added by St.1987, c. 549, § 5.

§ 28. Execution of development contract

(a) Within sixty days of the selection of the operator pursuant to section twenty-seven, the board shall execute a development contract under which such operator shall be obligated to fulfill all of the requirements of the facility approval process established in sections twenty-nine to thirty-four, inclusive, in accordance with the plan submitted by the operator pursuant to section twenty-seven or any revision thereof approved by the board, and specifying a bond to be posted in an amount to be determined by the board, payable to the board and conditioned on the faithful performance of the obligations, agreements and covenants specified in the development contract. The bond shall provide that, if the operator defaults on the development contract, it shall pay to the board all damages sustained as a result of the default. The deputy commissioner of the division of capital planning and operations shall assist the board in overseeing the operator's activities under the development contract and shall advise the board on the adequacy of such development activities. If no development contract is executed within sixty days of the designation of the operator or the required bond is not posted, the operator selection shall be set aside, and the procedures established in section twenty-seven shall be repeated in order to select a replacement operator; provided, however, that the community supervisory committee shall select such replacement operator within thirty days of the expiration of the time for the operator originally selected to execute the development contract or post the performance bond.

(b) Within thirty days of the execution of the development contract, the operator shall establish a field office within a site community outside the boundaries of the superior site.

Added by St.1987, c. 549, § 5.

§ 29. Phase IV of the Low-Level Radioactive Waste Management Act; facility approval and licensing

Facility approval and licensing shall be conducted in accordance with sections thirty to thirty-four, inclusive, which shall be known and be cited as "Phase IV of the Low-Level Radioactive Waste Management Act", and in accordance with the regulations adopted under section sixteen. The provisions of such sections and regulations shall be implemented so as to ensure an open and fair process for carrying out the environmental review and licensing of any facility for which a site, operator and technology have been selected pursuant to Phase III of the Low-Level Radioactive Waste Management Act and to require a comprehensive operating contract setting forth the rights and responsibilities of the board and the operator with respect to such facility.

Added by St.1987, c. 549, § 5.

§ 30. Notice of intent to apply for facility license; environmental impact report

(a) Except as otherwise provided in this section, the development, operation, closure, post-closure observation and maintenance and institutional control of a facility at any superior site shall be subject to sections sixty-one to sixty-two H, inclusive, of chapter thirty. No action taken pursuant to sections ten to twenty-eight, inclusive, shall be deemed to be a project within the meaning of section sixty-two of chapter thirty.

(b) Upon execution of the development contract pursuant to section twenty-eight, the operator shall prepare a notification to the secretary of the executive office of environmental affairs of the operator's intent to apply for a facility license pursuant to section thirty-one and for such other permits, as defined in section sixty-two of chapter thirty, as may be required by law for the development or operation of a facility at the superior site. The contents of such notification shall substantially conform to the plans submitted by the operator pursuant to section twenty-seven or any revision thereof approved by the board. Upon approval of the contents of the notification by the board, after consultation with the community supervisory committee of each site community, the notification shall be filed with said secretary in accordance with the provisions of section sixty-two A of chapter thirty, and a copy thereof shall be transmitted to the department of public health.

(c) Notwithstanding any provision of section sixty-two A of chapter thirty to the contrary, an environmental impact report shall be required on the proposed development, operation, closure, post-closure observation and maintenance and institutional control of a facility at any superior site. The report shall identify each community which can be expected to experience significant impacts as a result of the location, development, operation, closure, post-closure observation and maintenance and institutional control of the facility. In making a determination of the scope of the reports pursuant to such section, the secretary of the executive office of environmental affairs may require an examination of only those candidate sites identified pursuant to section twenty as alternative sites for the facility.

(d) The development, operation, closure, post-closure observation and maintenance and institutional control of a facility at any superior site shall be considered a major and complicated project within the meaning of section sixty-two A of chapter thirty. In establishing a specific procedure for evaluation and review of the environmental impacts of the project, said secretary shall appoint a citizens advisory committee in accordance with regulations adopted pursuant to such section to perform the functions established thereunder. The citizens advisory committee shall be composed of the members of the community supervisory committee of each site community and not more than six additional members selected by said secretary.

(e) The public and agency review periods of thirty days for the notice of availability of any draft or final report established by section sixty-two C of chapter thirty shall each be extended for a period of thirty days. During periods for review of the draft environmental impact report, said secretary shall hold at least one public meeting on the report in each site community and additional public meetings in neighboring communities upon request by the chief executive officer of any such community.

(f) The final facility license decision of the department of public health pursuant to section thirty-one shall not be subject to the requirements of section sixty-two D of chapter thirty.

Added by St.1987, c. 549, § 5. Amended by St.1988, c. 199, § 24.

Historical and Statutory Notes

1988 Legislation

St.1988, c. 199, § 24, an emergency act, approved July 26, 1988, in the first sentence of par.

(a), substituted "operation" for "operator".

§ 31. Facility license application; public comment period; preparation of draft license or draft denial; final decision

(a) Upon the filing with the secretary of the executive office of environmental affairs of a notification pursuant to section thirty of intent to apply for a facility license, the operator may file a facility license application with the department of public health in accordance with regulations adopted under section sixteen. The license application shall be determined to be complete when said department finds that all information required by such regulations has been submitted and any additional requirements established by regulation adopted under said section sixteen have been satisfied; provided, however, that nothing in this section shall prohibit said department from requiring an operator to submit additional information necessary to evaluate the application at any time prior to the final license decision. Said department may summarily deny a facility license if the operator fails or refuses to correct deficiencies in the application. Such summary denial shall be accompanied by an explanation of the reasons for the denial. For each complete application, said department shall set a decision schedule in accordance with its regulations adopted under said section sixteen setting forth the date by which it intends to prepare a draft license or draft denial; and to issue a final license decision. Said department shall adhere to such decision schedule unless it finds that an extension of the schedule, not to exceed ninety days, is necessary to protect the public health or the environment, in which case said department shall adhere to such decision schedule as

extended, provided, however, that nothing in this section shall authorize said department to issue a final facility license decision prior to action by the secretary of the executive office of environmental affairs on the final environmental impact report prepared pursuant to section thirty of this chapter and section sixty-two C of chapter thirty.

(b) The public comment period on a facility license application shall commence upon the filing of the notification of intent to apply for a facility license pursuant to section thirty. The recommendations of the public participation coordinator, made pursuant to section six, shall be implemented to the extent feasible in order to ensure public participation in the facility licensing process; to ensure that adequate information concerning the facility licensing process is available; to facilitate the conduct of public meetings and other opportunities for public review and comment; and to ensure that public concerns are identified and addressed throughout the facility licensing process. The department of public health shall give notice of the commencement of the public comment period by mail to the applicant, the community supervisory committee of each site community and the board and by publication in accordance with regulations adopted pursuant to section sixty-two A of chapter thirty, in a daily or weekly newspaper of general circulation within each site and neighboring community, and by broadcasting on radio stations serving each such community. The public comment period shall continue for forty-five days after the issuance of a draft license or draft denial pursuant to this section; provided, however, that said department shall extend the public comment period if it issues a modified draft license, until forty-five days after the issuance of such a modified draft license. During the public comment period, any person may submit comments in writing on any aspect of the application or the draft license or draft denial; copies of all written comments and memoranda prepared or received by said department shall be made available to persons upon request; and said department shall conduct at least one public meeting on the license application and the draft license or draft denial within each site community and other public meetings in neighboring communities upon request by the chief executive officer of such community.

(c) For each complete facility license application reviewed pursuant to this section, the department of public health shall, after action by the secretary of the executive office of environmental affairs on a draft environmental impact report pursuant to section thirty of this chapter and section sixty-two C of chapter thirty, prepare a draft license or draft denial. A draft license shall include facility design and performance specifications and all conditions required to operate the facility. A copy of the draft license or draft denial shall be sent to the operator, the community supervisory committee of each site community, the board and, upon request, to other interested persons, and shall be accompanied by an explanation of the reasons therefor and a description of the procedures to be followed in reaching a final license decision. Such description shall include the date on which the public comment period is to end; the dates and locations of scheduled public meetings on the draft license or draft denial, the procedures to be followed by persons wishing to participate in the process leading to the final license decision, and the name, address and telephone number of the person within said department to contact for additional information.

(d) A copy of the department of public health's final facility license decision shall be sent to the applicant, the community supervisory committee of each site community, the board, any person who submitted written comments during the public comment period and, upon request, to other interested persons. Such final decision shall be accompanied by a summary response to comments received during the public comment period and an explanation of the reasons for any difference between the draft license or denial and the final license decision.

Added by St.1987, c. 549, § 5.

§ 32. [Blank]

§ 33. Negotiation of comprehensive operating contract; contents

(a) Upon issuance of a facility license pursuant to section thirty-one, the board, after consultation with the community supervisory committee of each site community, and the

operator shall negotiate a comprehensive operating contract setting forth, consistent with the management plan adopted under section twelve, the rights and responsibilities of each party with respect to the facility and specifying that site, affected and neighboring communities are third party beneficiaries. The board and the operator shall execute such contract upon the appropriation of funds necessary to ensure that the board can satisfy the community compensation responsibilities thereunder. Such contract shall specify the terms on which the superior site is to be leased to the operator, shall set forth design and performance specifications for the facility, shall establish the right of the board to supervise all aspects of the development, operation, closure and post-closure observation and maintenance of the facility, and shall set the condition that must be satisfied prior to transfer of the facility license pursuant to section forty-six. The deputy commissioner of the division of capital planning and operations shall assist the board in overseeing the development of the facility and shall advise the board on the adequacy of all development activities. The comprehensive operating contract shall also provide that the board may modify or terminate the contract if it determines that a change in the ownership or control, or in the directors or officers of the operator or a change in any of its principal subcontractors may adversely affect the safe development, operation, closure or post-closure observation and maintenance of the facility. In addition, the contract shall provide that:

(1) The operator shall abide by all covenants proposed to be made to each site, neighboring and affected community in the application filed pursuant to section twenty-two or in any written statements submitted pursuant to section twenty-seven.

(2) The board shall abide by any additional covenants undertaken for the benefit of site, affected or neighboring communities which it deems necessary and appropriate. Such covenants may include obligations to reimburse a community for road maintenance or reconstruction or other increased infrastructure costs resulting from siting, development or operation of a facility.

(3) The operator shall annually pay to each site community, during the period commencing with the issuance of a facility license, pursuant to section thirty-one and ending with the transfer of such license to the board pursuant to section forty-six, a sum equal to the amount due to such community in real property taxes, provided, however, upon the transfer of the license from the operator to the board pursuant to section forty-six, each site community, during the period of institutional control, shall receive an amount in lieu of local property taxes in accordance with section seventeen of chapter fifty-eight.

(4) The operator shall annually pay to the site community during the period of the facility's operation, a sum equal to four per cent of the annual gross operating receipts of the facility; provided, however, that, except during the first calendar year of a facility's operation, if the facility accepts less than one hundred thousand cubic feet of low-level radioactive waste in any calendar year, the sum to be paid to the site community pursuant to this section shall not be less than two hundred forty thousand dollars; if the facility accepts one hundred thousand cubic feet or more, but less than two hundred thousand cubic feet, of low-level radioactive waste in any calendar year, the sum to be paid to the site community pursuant to this section shall not be less than three hundred twenty thousand dollars; and if the facility accepts two hundred thousand cubic feet or more of low-level radioactive waste in any calendar year, the sum to be paid to the site community pursuant to this section shall not be less than four hundred thousand dollars; during the first calendar year of a facility's operation, the minimum sum to be paid to the site community pursuant to this section shall be prorated in accordance with a schedule to be agreed upon by the operator and the board. In addition to any other amounts paid pursuant to this paragraph, the operator shall pay one hundred and fifty thousand dollars per year, pro rata, to the site community during the period commencing with the opening of the facility and ending five years after the issuance of a facility license. If a facility is located in more than one community, all amounts paid pursuant to this paragraph shall be divided among the site communities in accordance with the formula established pursuant to section thirty-four.

(5) The operator shall annually pay to the neighboring communities during the period of the facility's operation, a sum equal to one per cent of the annual gross operating

receipts of the facility; provided, however, that, except during the first calendar year of a facility's operation, if the facility accepts less than one hundred thousand cubic feet of low-level radioactive waste in any calendar year, the sum to be paid to neighboring communities pursuant to this section shall not be less than sixty thousand dollars; if the facility accepts one hundred thousand cubic feet or more, but less than two hundred thousand cubic feet, of low-level radioactive waste in any calendar year, the sum to be paid to neighboring communities pursuant to this section shall not be less than eighty thousand dollars; and if the facility accepts two hundred thousand cubic feet or more of low-level radioactive waste in any calendar year, the sum to be paid to neighboring communities pursuant to this section shall not be less than one hundred thousand dollars; during the first calendar year of a facility's operation, the minimum sum to be paid to the site community pursuant to this section shall be provided in accordance with a schedule to be agreed upon by the operator and the board; and provided, further, that such sum shall be divided among such communities in accordance with formula established pursuant to section thirty-four.

(6) The operator shall collect a surcharge, established pursuant to section thirty-eight, for the Low-level Radioactive Waste Trust Fund, established in section forty-one, and shall promptly remit the amounts collected, together with any interest accrued thereon, to the state treasurer as treasurer of such Fund.

Added by St.1987, c. 549, § 5.

§ 34. Community compensation

Any community compensation to be provided for site communities pursuant to the comprehensive operating contract shall be divided among such communities in the proportion that each community's population residing within three miles of the facility bears to the total population of site communities within such area. The community compensation to be provided for neighboring communities pursuant to the comprehensive operating contract shall be divided among such communities in the proportion that each community's population residing within three miles of the facility bears to the total population of such communities within such area; provided, however, that if the facility has no neighboring communities, such community compensation shall be divided among the site communities in accordance with the formula established in this section.

Added by St.1987, c. 549, § 5.

§ 35. Phase V of the Low-Level Radioactive Waste Management Act; facility development, operation, and closure

Facility development, operation, closure, and post-closure observation and maintenance shall be conducted in accordance with sections thirty-six to forty-four, inclusive, shall be known and be cited as "Phase V of the Low-Level Radioactive Waste Management Act", and in accordance with the regulations adopted by the department of public health under section sixteen. The provisions of such sections and regulations shall be implemented so as to provide for the safe and orderly development, operation, closure and post-closure observation and maintenance of any facility licensed pursuant to "Phase IV of the Low-Level Radioactive Waste Management Act".

Added by St.1987, c. 549, § 5.

§ 36. Comprehensive environmental monitoring program; establishment

(a) Within thirty days of the issuance of a facility license pursuant to section thirty-one; the department of public health shall, after consultation with the department of environmental protection and the board of health of each site community, establish a comprehensive environmental monitoring program at the facility site. Such program shall employ the best available monitoring technology and shall provide, to the maximum extent feasible, for the participation of officials and citizens of each site community and the training of such persons to facilitate their participation. The program shall be designed to establish baseline environmental data on the site; to determine compliance

with applicable regulations, with conditions of the facility license and with terms of the comprehensive operating contract; to provide early warning of the magnitude and extent of any radionuclide migration; and to provide reliable environmental data throughout development, operation, closure, post-closure operation and maintenance and institution control of the facility. The program shall collect and analyze data concerning standing and running surface water and drainage; groundwater samples from offsite, site boundary and waste management area wells; soil and vegetation samples; atmospheric samples; and radiation measurements offsite, at the site boundary and in the waste management area. The board of health of each site community shall be entitled to obtain portions of the samples collected pursuant to the program for independent analysis by a laboratory certified to conduct such analyses by the United States Environmental Protection Agency.

(b) The operator shall, according to applicable regulations and conditions of the facility license, cooperate with the environmental monitoring program and annually reimburse the department of public health and each site community for the costs thereof until the facility license is transferred to the board pursuant to section forty-six. A copy of all environmental monitoring records and analyses shall be kept at the board field office in the site community for public review.

(c) The department of public health shall annually issue a report describing and evaluating the findings of the monitoring program. Within sixty days of issuance of such report, said department shall hold a public meeting in each site community and, upon request by the chief executive officer of such community, in each affected and neighboring community for public review and comment upon the findings contained therein. Said department shall consider and evaluate all comments made at such public meetings or submitted in writing within sixty days of the issuance of the report.

Added by St.1987, c. 549, § 5. Amended by St.1990, c. 177, § 215.

Historical and Statutory Notes

1990 Legislation

St.1990, c. 177, § 215, an emergency act, approved Aug. 7, 1990, in par. (a), in the first

sentence, substituted "protection" for "quality engineering".

§ 37. Commencement of facility construction

Upon the determination of the department of public health that the environmental monitoring program or detailed site characterization of the superior site has yielded representative baseline data, the operator may commence construction of the facility. The operator shall construct, install and, from time to time, in accordance with the regulations adopted under section sixteen and the conditions of its facility license, make additions or improvements to such structures and equipment as are necessary to operate the facility. Said department shall, in cooperation with officials of each site community and according to the regulations adopted pursuant to said section sixteen, periodically inspect such construction to ensure that such regulations and the conditions of the license are satisfied. The board shall appoint a resident engineer having the experience and expertise specified in section forty-two J of chapter seven, who shall represent the board daily at the superior site during the construction of the facility and who shall, in cooperation with officials of each site community, check, inspect and report to the board as to events at the construction site, in order to ensure that the terms of the comprehensive operating contract are satisfied. The deputy commissioner of the division of capital planning and operations shall assist said department and the board in fulfilling their obligations under this section, and shall advise them on the adequacy of construction activities.

Added by St.1987, c. 549, § 5.

§ 38. Payment by operator equal to expected annual operating budget; proposed fees and waste acceptance criteria schedule

(a) Upon the issuance of a facility license pursuant to section thirty-one, and annually thereafter, until the facility license is transferred to the board pursuant to section forty-

six, the department of public health shall establish a payment to be made by the operator equal to said departments expected annual operating budget for the next fiscal year for its activities with respect to the facility other than those for which reimbursement has been made pursuant to section thirty-six; provided, however, that such payment shall be adjusted by the amount of any operating deficit or surplus, previously incurred by said department with respect to such activities, in accordance with procedures established by regulation of said department. The operator shall make such payment to the commonwealth prior to the commencement of the fiscal year.

(b) The operator shall annually submit to the board a proposed schedule of fees and criteria for acceptance of low-level radioactive waste. Such schedule shall be based on the classification system contained in the management plan adopted pursuant to section twelve, shall be designed so as to promote source minimization, volume minimization and storage for decay by generators, shall establish service charges for waste shipments found not to be in compliance with applicable regulations and conditions of the facility license, and shall establish fees which are adequate to reimburse the operator for all reasonable expenses of facility development and operation; all reasonable community compensation guaranteed to site, neighboring and affected communities in the comprehensive operating contract executed pursuant to section thirty-three; the department of public health's required annual payment established pursuant to this section; and a reasonable profit from the operation of the facility; and shall establish waste acceptance criteria, consistent with the management plan and adequate to assure proper and efficient operation of the facility; source minimization, volume minimization and storage for decay in compliance with the regulations adopted by said department pursuant to section thirteen; and conservation of facility resources. Such waste acceptance criteria shall specify that no low-level radioactive waste shall be accepted from an electric-power-generating facility if such waste requires management more stringent than the most stringent management required for any low-level radioactive waste which may be accepted at the facility from another generator. The operator's proposed schedule shall be accompanied by a certified audit of gross operating receipts from fees and surcharges imposed for acceptance of low-level radioactive waste at the facility during the current and prior fiscal years and a verification under oath that all compensation required to be paid by the operator to each site, neighboring and affected community by the comprehensive operating contract has been paid, and that all surcharges collected for the Low-Level Radioactive Waste Trust Fund have been remitted to the state treasurer in accordance with the requirements of the comprehensive operating contract executed pursuant to section thirty-three. All books and records of the operator shall be subject to audit pursuant to section twelve of chapter eleven.

(c) The board, after notice and opportunity for hearing, shall approve, modify or reject the schedule of fees and waste acceptance criteria submitted by the operator and establish annually a schedule of surcharges for the Low-Level Radioactive Waste Trust Fund established in section forty-one. Such fees, criteria and surcharges shall be imposed as conditions of acceptance of all low-level radioactive waste at the facility until a new or revised schedule is approved by the board.

Added by St.1987, c. 549, § 5. Amended by St.1988, c. 199, § 25.

Historical and Statutory Notes

1988 Legislation

St.1988, c. 199, § 25, an emergency act, approved July 26, 1988, in the third sentence of

par. (b), substituted "more stringent than" for "more stringent that".

§ 39. Determination of operator's compliance with comprehensive operating contract; notice to generators

(a) Upon written notification by the operator that the facility is ready to accept low-level radioactive waste, and upon written notification by the department of public health that the facility is in compliance with all regulations and conditions of the facility license, the board shall determine whether the operator is in compliance with the comprehensive operating contract. If it is so determined, then the facility shall commence operation.

(b) Within seven days of the board's determination, the operator shall notify all generators of the date on which the operator will accept low-level radioactive waste from such generators. Included in such notice shall be a statement of the terms, conditions and criteria for low-level radioactive waste acceptance at the facility.

Added by St.1987, c. 549, § 5.

§ 40. Operation of facility; temporary or permanent closure; inspection report

(a) The facility shall be operated in accordance with this section and with regulations adopted under section sixteen. All shipments of low-level radioactive waste shall, upon arrival at the facility, enter the facility, but shall not proceed into the waste management area for unloading until inspected by the department of public health and found to be in compliance with applicable regulations and conditions of the facility license. Shipments found not to be in compliance shall proceed to a controlled area within the facility to await action to remedy the situation, and the board of health of each site community shall be so notified by the operator. Shipments found to be in compliance shall proceed into the waste management area for unloading. After a transport vehicle is unloaded and leaves the waste management area, it shall not leave the facility until it is again inspected by the department of public health and decontaminated, if necessary.

(b) The department of public health, in consultation with the board, may issue an order temporarily or permanently closing a facility prior to its scheduled closing date if it finds that there is a potential hazard to public health, safety or the environment which justifies such temporary or permanent closure. A facility that is temporarily closed shall remain closed as long as necessary for remedial action and, in any event, throughout any period of facility clean-up and stabilization. Prior to authorizing the reopening of a temporarily closed facility, said department shall conduct at least one public meeting on the reopening in each site community and other public meetings in neighboring communities upon request by the chief executive officer of such community, and shall issue a summary response to all comments made at such public meetings or made in writing during the time the facility is temporarily closed and an explanation of the reasons for authorizing the reopening.

(c) The department of public health shall annually prepare a report summarizing its inspection and enforcement activities with respect to the facility and shall transmit a copy of such report to the board and the board of health of each site community.

Added by St.1987, c. 549, § 5. Amended by St.1988, c. 199, §§ 26, 27.

Historical and Statutory Notes

1988 Legislation

St.1988, c. 199, § 26, an emergency act, approved July 26, 1988, in the first sentence of par. (b), substituted "The" for "the".

Section 27 of St.1988, c. 199, in par. (c), substituted "The" for "the".

§ 41. Contingent liability account; institutional control account

(a) There is hereby established within the Low-Level Radioactive Waste Trust Fund, a contingent liability account and the institutional control account. The board shall determine annually the amount of revenues, raised from the surcharges imposed pursuant to section thirty-eight, that shall be deposited within each account; provided, however, that after such deposits, no amounts so deposited may be transferred between such accounts.

(b) The contingent liability account shall be used to pay compensation for injuries to persons, land or property resulting from the management of low-level radioactive waste pursuant to section nine.

(c) The institutional control account shall be used to pay institutional control costs pursuant to sections nine and forty-seven. The account shall be used by the board to purchase insurance coverage or otherwise to ensure the availability of funds to meet liability claims during the institutional control period; provided, however, that no portion

of the monies held in the institutional control account may be used to satisfy judgments or settlements pursuant to section nine or for any other purpose other than institutional control of a facility.

Added by St.1987, c. 549, § 5.

§ 42. Administration of the Low-Level Radioactive Waste Trust Fund

The Low-Level Radioactive Waste Trust Fund, established by section thirty-five H of chapter ten, shall be administered by the board, without liability on the part of the commonwealth beyond the amounts credited to and earned by the fund.

The treasurer shall make payments from accounts of said fund upon receipt of a warrant listing all payments to be made and the accounts to be debited, which has been approved in writing by the board.

The state treasurer shall on or before July first of each year, submit to the board, the governor, the clerk of the senate and the clerk of the house of representatives, an annual report for the previous fiscal year. Said report shall include a statement of the revenues and disbursements of said Fund for the fiscal year, the balance at the beginning and the end of the fiscal year for each account within the trust fund, and any other information the treasurer deems appropriate.

Added by St.1987, c. 549, § 5.

§ 43. Facility closure plan

(a) At least one year prior to the date scheduled for facility closure in the facility closure plan required to be prepared and maintained by regulations issued pursuant to section sixteen, the operator shall submit such plan to the department of public health and the management board. Said department shall conduct a public meeting on the plan at times to be determined after consultation with the board in each site community and other public meetings in neighboring communities upon request by the chief executive officer of such community. The board shall participate in each such public meeting. Said department shall accept written comments on the plan submitted by any interested person within forty-five days of the public notice of the availability of the plan. Prior to its acceptance of the plan said departments shall consider and evaluate all comments made at a public meeting or submitted in writing.

(b) Upon acceptance of such plan by said department and the board, the operator shall implement such plan according to the closure schedule contained therein. Said department shall, in cooperation with appropriate officials of each site community and according to regulations adopted pursuant to section sixteen, periodically inspect the operator's implementation of the facility closure plan to ensure that such regulations and the conditions of the facility license are satisfied. The board shall, in cooperation with appropriate officials of each site community, periodically, inspect the operator's implementation of the facility closure plan to ensure that the terms of the comprehensive operating contract are satisfied and that steps necessary to allow the board to accept transfer of the facility license pursuant to section forty-six are taken.

Added by St.1987, c. 549, § 5.

§ 44. Active observation and maintenance of facility

Upon completion of site closure activities, the operator shall, for no less than five years thereafter, engage in active observation and maintenance of the facility in accordance with regulations adopted pursuant to section sixteen and the conditions of the facility license. By the end of such time, the operator shall transfer all records of its development, operation, closure and post-closure observation and maintenance of the facility to the board.

Added by St.1987, c. 549, § 5.

§ 45. Phase VI of the Low-Level Radioactive Waste Management Act; institutional control of facility

Institutional control of a facility shall be conducted, subject to appropriation, in accordance with sections forty-six and forty-seven, which shall be known and may be cited as "Phase VI of the Low-Level Radioactive Waste Management Act", and in accordance with the regulations adopted pursuant to section sixteen. The provisions of these sections and regulations shall be implemented so as to provide for the safe and orderly institutional control of a facility following transfer of the facility license from the operator to the board.

Added by St.1987, c. 549, § 5.

§ 46. Transfer of facility license from operator

(a) No sooner than five years after the implementation of the site closure plan pursuant to section forty-four, the board shall accept transfer of the facility license from the operator, if it determines that the operator has fulfilled all of its obligations under the comprehensive operating contract executed pursuant to section thirty-three. No fewer than ninety days prior to such vote, the board shall issue a draft plan for institutional control of the facility in accordance with the regulations adopted under section sixteen for public review and comment. The board shall conduct a public meeting on the plan of each site community and other public meetings in neighboring communities upon request by the chief executive officer of such community. The board shall accept written comments on the plan submitted by any interested person within forty-five days of the public notice of the availability of the plan. Prior to its vote to accept transfer of the license and adopt the plan, the board shall consider and evaluate all comments made at a public meeting or submitted in writing.

(b) Upon the board's decision to accept transfer of the facility license the department of public health shall, after notice and opportunity for hearing, determine whether to allow such transfer. The decision of said department to approve facility license transfer shall be based on a determination that the operator's obligations under section forty-four have been fulfilled and that the board's program for institutional control of the facility is adequate to protect the public health, safety and the environment. Such decision shall specify, based on the characterization of the facility and of the low-level radioactive waste present at the site, a period of time during which institutional control shall continue, or a procedure for approving termination by the board of institutional control following a specified period of time. The institutional control period shall not be less than the minimum time required for any low-level radioactive waste present at the site to decay to the maximum concentrations above natural background levels permitted to be released into air or water in unrestricted areas under federal and state law.

(c) The operator shall not be required to submit a report to the state ethics commission and the inspector general, in accordance with section twenty-two, for any year after the year during which the facility license is transferred pursuant to this section.

Added by St.1987, c. 549, § 5.

§ 47. Institutional control of facility; annual report; public meetings

The board shall be responsible for institutional control of the facility in accordance with the program approved by the department of public health and regulations adopted pursuant to section sixteen. The board shall annually issue a report of its institutional control of the facility for public review and comment. Within sixty days of issuance of such report, the board shall hold a public meeting in each site community and other public meetings in neighboring communities upon request by the chief executive officer of such community. The board shall consider and evaluate all comments made at such public meetings or submitted in writing within sixty days of the issuance of the report. Said department shall issue an annual report of the supervision of such institutional control activities for public review and comment. Within sixty days of issuance of such report, said department shall hold a public meeting in each site community and other public

meetings in neighboring communities, upon request by the chief executive officer of such community. Said department shall consider and evaluate all comments made at such public meetings or submitted in writing within sixty days of the issuance of the report.

Added by St.1987, c. 549, § 5.

§ 48. Statutes not applicable

The selection of an operator and the development of a facility pursuant to this chapter shall, for the purposes of section forty-two B of chapter seven, be construed as an alternative method of design and construction services approved by the legislature, and shall not be subject to sections thirty-eight A1/2 to thirty-eight N, inclusive, of said chapter seven or of sections forty-four A to forty-four J, inclusive, of chapter one hundred and forty-nine.

Added by St.1987, c. 549, § 5.

INDEX

CONSULT GENERAL INDEX

†

Chapter 549 of the Acts of 1987
Section 6

Chapter 549 of the Acts of 1987

Section 6

The low-level radioactive waste management board, established under the provisions of section two of chapter one hundred and eleven G¹ of the General Laws is hereby authorized and directed to represent the commonwealth in any and all negotiations with other states for the purpose of reaching an interstate compact agreement to provide for the establishment and operation of regional disposal facilities for low-level radioactive waste. In carrying out the duties established hereunder, said board may initiate negotiations with any state it deems appropriate to meet the needs of the commonwealth with respect to such facilities upon a majority vote of the board. The board shall include as part of its management plan adopted pursuant to section eleven of chapter one hundred and eleven H of the General Laws a detailed report which shall include a summary of all negotiations conducted prior to the establishment of the board, a study of the feasibility of the commonwealth entering into a regional compact which shall identify those states the board deems appropriate for the commonwealth to negotiate with. After the issuance of the detailed report the board shall report semiannually to the joint committee on natural resources on its progress in its negotiations for a regional compact which shall include any additional states which the board determined it is appropriate to negotiate with or any other developments which impact on the establishment of an interstate compact, including any cost to the commonwealth for the disposal of low-level radioactive waste or the volume of waste to be stored in the commonwealth arising from the regional compact negotiations.

¹ So In original; probably should read "chapter one hundred and eleven H".

Public Law 96-573
December 22, 1980

Public Law 96-573
December 22, 1980

An Act

To set forth a Federal policy for the disposal of low-level radioactive wastes, and for other purposes.

Dec. 22, 1980

[S. 2189]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Low-Level
Radioactive
Waste Policy
Act.

SHORT TITLE

SECTION 1. This Act may be cited as the "Low-Level Radioactive Waste Policy Act".

42 USC 2021b
note.

DEFINITIONS

SEC. 2. As used in this Act—

42 USC 2021b.

(1) The term "disposal" means the isolation of low-level radioactive waste pursuant to requirements established by the Nuclear Regulatory Commission under applicable laws.

(2) The term "low-level radioactive waste" means radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in section 11 e. (2) of the Atomic Energy Act of 1954.

(3) The term "State" means any State of the United States, the District of Columbia, and, subject to the provisions of Public Law 96-205, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and any other territory or possession of the United States.

(4) For purposes of this Act the term "atomic energy defense activities of the Secretary" includes those activities and facilities of the Department of Energy carrying out the function of—

- (i) Naval reactors development and propulsion,
- (ii) weapons activities, verification and control technology,
- (iii) defense materials production,
- (iv) inertial confinement fusion,
- (v) defense waste management, and
- (vi) defense nuclear materials security and safeguards (all as included in the Department of Energy appropriations account in any fiscal year for atomic energy defense activities).

GENERAL PROVISIONS

SEC. 3. (a) Compacts established under this Act or actions taken under such compacts shall not be applicable to the transportation, management, or disposal of low-level radioactive waste from atomic energy defense activities of the Secretary or Federal research and development activities.

42 USC 2021c.

(b) Any facility established or operated exclusively for the disposal of low-level radioactive waste produced by atomic energy defense activities of the Secretary or Federal research and development

activities shall not be subject to compacts established under this Act or actions taken under such compacts.

LOW-LEVEL RADIOACTIVE WASTE DISPOSAL

State compacts
regarding
regional
facilities.
42 USC 2021d.

SEC. 4. (a)(1) It is the policy of the Federal Government that—

(A) each State is responsible for providing for the availability of capacity either within or outside the State for the disposal of low-level radioactive waste generated within its borders except for waste generated as a result of defense activities of the Secretary or Federal research and development activities; and

(B) low-level radioactive waste can be most safely and efficiently managed on a regional basis.

(2)(A) To carry out the policy set forth in paragraph (1), the States may enter into such compacts as may be necessary to provide for the establishment and operation of regional disposal facilities for low-level radioactive waste.

Congressional
consent.

(B) A compact entered into under subparagraph (A) shall not take effect until the Congress has by law consented to the compact. Each such compact shall provide that every 5 years after the compact has taken effect the Congress may by law withdraw its consent. After January 1, 1986, any such compact may restrict the use of the regional disposal facilities under the compact to the disposal of low-level radioactive waste generated within the region.

Report to
Congress and
States.

(b)(1) In order to assist the States in carrying out the policy set forth in subsection (a)(1), the Secretary shall prepare and submit to Congress and to each of the States within 120 days after the date of the enactment of this Act a report which—

(A) defines the disposal capacity needed for present and future low-level radioactive waste on a regional basis;

(B) defines the status of all commercial low-level radioactive waste disposal sites and includes an evaluation of the license status of each such site, the state of operation of each site, including operating history, an analysis of the adequacy of disposal technology employed at each site to contain low-level radioactive wastes for their hazardous lifetimes, and such recommendations as the Secretary considers appropriate to assure protection of the public health and safety from wastes transported to such sites;

(C) evaluates the transportation requirements on a regional basis and in comparison with performance of present transportation practices for the shipment of low-level radioactive wastes, including an inventory of types and quantities of low-level wastes, and evaluation of shipment requirements for each type of waste and an evaluation of the ability of generators, shippers, and carriers to meet such requirements; and

(D) evaluates the capability of the low-level radioactive waste disposal facilities owned and operated by the Department of Energy to provide interim storage for commercially generated low-level waste and estimates the costs associated with such interim storage.

(2) In carrying out this subsection, the Secretary shall consult with the Governors of the States, the Nuclear Regulatory Commission, the Environmental Protection Agency, the United States Geological Survey, and the Secretary of Transportation, and such other agencies and departments as he finds appropriate.

Approved December 22, 1980.

LEGISLATIVE HISTORY:

SENATE REPORT No. 96-548 (Comm. on Energy and Natural Resources).
CONGRESSIONAL RECORD, Vol. 126 (1980):

July 28-30, considered and passed Senate.

Dec. 3, H.R. 8378 considered and passed House; passage vacated and S. 2189, amended, passed in lieu.

Dec. 13, Senate agreed to the House amendment with amendments; House agreed to Senate amendments.

Public Law 99-240
January 15, 1986

Public Law 99-240
January 15, 1986

An Act

Jan. 15, 1986
[H.R. 1083]

To amend the Low-Level Radioactive Waste Policy Act to improve procedures for the implementation of compacts providing for the establishment and operation of regional disposal facilities for low-level radioactive waste; to grant the consent of the Congress to certain interstate compacts on low-level radioactive waste; and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

State and local
governments.

Low-Level
Radioactive
Waste Policy
Amendments
Act of 1985.
42 USC 2021b
note.

TITLE I—LOW-LEVEL RADIOACTIVE WASTE POLICY
AMENDMENTS ACT OF 1985

SEC. 101. SHORT TITLE.

This Title may be cited as the "Low-Level Radioactive Waste Policy Amendments Act of 1985".

SEC. 102. AMENDMENT TO THE LOW-LEVEL RADIOACTIVE WASTE POLICY
ACT.

42 USC
2021b-2021d,
2021b note.

The Low-Level Radioactive Waste Policy Act (42 U.S.C. 2021b et seq.) is amended by striking out sections 1, 2, 3, and 4 and inserting in lieu thereof the following:

42 USC 2021b
note.

"SECTION 1. SHORT TITLE.

"This Act may be cited as the 'Low-Level Radioactive Waste Policy Act'.

42 USC 2021b.

"SEC. 2. DEFINITIONS.

"For purposes of this Act:

"(1) AGREEMENT STATE.—The term 'agreement State' means a State that—

"(A) has entered into an agreement with the Nuclear Regulatory Commission under section 274 of the Atomic Energy Act of 1954 (42 U.S.C. 2021); and

"(B) has authority to regulate the disposal of low-level radioactive waste under such agreement.

"(2) ALLOCATION.—The term 'allocation' means the assignment of a specific amount of low-level radioactive waste disposal capacity to a commercial nuclear power reactor for which access is required to be provided by sited States subject to the conditions specified under this Act.

"(3) COMMERCIAL NUCLEAR POWER REACTOR.—The term 'commercial nuclear power reactor' means any unit of a civilian light-water moderated utilization facility required to be licensed under section 103 or 104b. of the Atomic Energy Act of 1954 (42 U.S.C. 2133 or 2134(b)).

"(4) COMPACT.—The term 'compact' means a compact entered into by two or more States pursuant to this Act.

"(5) **COMPACT COMMISSION.**—The term 'compact commission' means the regional commission, committee, or board established in a compact to administer such compact.

"(6) **COMPACT REGION.**—The term 'compact region' means the area consisting of all States that are members of a compact.

"(7) **DISPOSAL.**—The term 'disposal' means the permanent isolation of low-level radioactive waste pursuant to the requirements established by the Nuclear Regulatory Commission under applicable laws, or by an agreement State if such isolation occurs in such agreement State.

"(8) **GENERATE.**—The term 'generate', when used in relation to low-level radioactive waste, means to produce low-level radioactive waste.

"(9) **LOW-LEVEL RADIOACTIVE WASTE.**—The term 'low-level radioactive waste' means radioactive material that—

"(A) is not high-level radioactive waste, spent nuclear fuel, or byproduct material (as defined in section 11e.(2) of the Atomic Energy Act of 1954 (42 U.S.C. 2014(e)(2))); and

"(B) the Nuclear Regulatory Commission, consistent with existing law and in accordance with paragraph (A), classifies as low-level radioactive waste.

"(10) **NON-SITED COMPACT REGION.**—The term 'non-sited compact region' means any compact region that is not a sited compact region.

"(11) **REGIONAL DISPOSAL FACILITY.**—The term 'regional disposal facility' means a non-Federal low-level radioactive waste disposal facility in operation on January 1, 1985, or subsequently established and operated under a compact.

"(12) **SECRETARY.**—The term 'Secretary' means the Secretary of Energy.

"(13) **SITED COMPACT REGION.**—The term 'sited compact region' means a compact region in which there is located one of the regional disposal facilities at Barnwell, in the State of South Carolina; Richland, in the State of Washington; or Beatty, in the State of Nevada.

South Carolina.
Washington.
Nevada.

"(14) **STATE.**—The term 'State' means any State of the United States, the District of Columbia, and the Commonwealth of Puerto Rico.

"SEC. 3. RESPONSIBILITIES FOR DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTE. 42 USC 2021c.

"SECTION 3(a)(1) STATE RESPONSIBILITIES.—Each State shall be responsible for providing, either by itself or in cooperation with other States, for the disposal of—

"(A) low-level radioactive waste generated within the State (other than by the Federal Government) that consists of or contains class A, B, or C radioactive waste as defined by section 61.55 of title 10, Code of Federal Regulations, as in effect on January 26, 1983;

"(B) low-level radioactive waste described in subparagraph (A) that is generated by the Federal Government except such waste that is—

Vessels.

"(i) owned or generated by the Department of Energy;

"(ii) owned or generated by the United States Navy as a result of the decommissioning of vessels of the United States Navy; or

Research and
development.

Post, pp. 1846,
1855.

Vessels.

Research and
development.

Health.
Safety.

42 USC 2011
note.

Report.

"(iii) owned or generated as a result of any research, development, testing, or production of any atomic weapon; and

"(C) low-level radioactive waste described in subparagraphs (A) and (B) that is generated outside of the State and accepted for disposal in accordance with sections 5 or 6.

"(2) No regional disposal facility may be required to accept for disposal any material—

"(A) that is not low-level radioactive waste as defined by section 61.55 of title 10, Code of Federal Regulations, as in effect on January 26, 1983, or

"(B) identified under the Formerly Utilized Sites Remedial Action Program.

Nothing in this paragraph shall be deemed to prohibit a State, subject to the provisions of its compact, or a compact region from accepting for disposal any material identified in subparagraph (A) or (B).

"(b)(1) The Federal Government shall be responsible for the disposal of—

"(A) low-level radioactive waste owned or generated by the Department of Energy;

"(B) low-level radioactive waste owned or generated by the United States Navy as a result of the decommissioning of vessels of the United States Navy;

"(C) low-level radioactive waste owned or generated by the Federal Government as a result of any research, development, testing, or production of any atomic weapon; and

"(D) any other low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the Commission for class C radioactive waste, as defined by section 61.55 of title 10, Code of Federal Regulations, as in effect on January 26, 1983.

"(2) All radioactive waste designated a Federal responsibility pursuant to subparagraph (b)(1)(D) that results from activities licensed by the Nuclear Regulatory Commission under the Atomic Energy Act of 1954, as amended, shall be disposed of in a facility licensed by the Nuclear Regulatory Commission that the Commission determines is adequate to protect the public health and safety.

"(3) Not later than 12 months after the date of enactment of this Act, the Secretary shall submit to the Congress a comprehensive report setting forth the recommendations of the Secretary for ensuring the safe disposal of all radioactive waste designated a Federal responsibility pursuant to subparagraph (b)(1)(D). Such report shall include—

"(A) an identification of the radioactive waste involved, including the source of such waste, and the volume, concentration, and other relevant characteristics of such waste;

"(B) an identification of the Federal and non-Federal options for disposal of such radioactive waste;

"(C) a description of the actions proposed to ensure the safe disposal of such radioactive waste;

"(D) a description of the projected costs of undertaking such actions;

"(E) an identification of the options for ensuring that the beneficiaries of the activities resulting in the generation of such radioactive wastes bear all reasonable costs of disposing of such wastes; and

“(F) an identification of any statutory authority required for disposal of such waste.

Prohibition.
Report.

“(4) The Secretary may not dispose of any radioactive waste designated a Federal responsibility pursuant to paragraph (b)(1)(D) that becomes a Federal responsibility for the first time pursuant to such paragraph until ninety days after the report prepared pursuant to paragraph (3) has been submitted to the Congress.

“SEC. 4. REGIONAL COMPACTS FOR DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTE.

42 USC 2021d.

“(a) IN GENERAL.—

“(1) FEDERAL POLICY.—It is the policy of the Federal Government that the responsibilities of the States under section 3 for the disposal of low-level radioactive waste can be most safely and effectively managed on a regional basis.

Ante, p. 1843.

“(2) INTERSTATE COMPACTS.—To carry out the policy set forth in paragraph (1), the States may enter into such compacts as may be necessary to provide for the establishment and operation of regional disposal facilities for low-level radioactive waste.

“(b) APPLICABILITY TO FEDERAL ACTIVITIES.—

“(1) IN GENERAL.—

“(A) ACTIVITIES OF THE SECRETARY.—Except as provided in subparagraph (B), no compact or action taken under a compact shall be applicable to the transportation, management, or disposal of any low-level radioactive waste designated in section 3(a)(1)(B) (i)–(iii).

Prohibition.

“(B) FEDERAL LOW-LEVEL RADIOACTIVE WASTE DISPOSED OF AT NON-FEDERAL FACILITIES.—Low-level radioactive waste owned or generated by the Federal Government that is disposed of at a regional disposal facility or non-Federal disposal facility within a State that is not a member of a compact shall be subject to the same conditions, regulations, requirements, fees, taxes, and surcharges imposed by the compact commission, and by the State in which such facility is located, in the same manner and to the same extent as any low-level radioactive waste not generated by the Federal Government.

“(2) FEDERAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITIES.—Any low-level radioactive waste disposal facility established or operated exclusively for the disposal of low-level radioactive waste owned or generated by the Federal Government shall not be subject to any compact or any action taken under a compact.

Prohibition.

“(3) EFFECT OF COMPACTS ON FEDERAL LAW.—Nothing contained in this Act or any compact may be construed to confer any new authority on any compact commission or State—

Prohibition.

“(A) to regulate the packaging, generation, treatment, storage, disposal, or transportation of low-level radioactive waste in a manner incompatible with the regulations of the Nuclear Regulatory Commission or inconsistent with the regulations of the Department of Transportation;

Transportation.
Regulations.

“(B) to regulate health, safety, or environmental hazards from source material, byproduct material, or special nuclear material;

Health.
Safety.
Pollution.

“(C) to inspect the facilities of licensees of the Nuclear Regulatory Commission;

Government
organization and
employees.

“(D) to inspect security areas or operations at the site of the generation of any low-level radioactive waste by the Federal Government, or to inspect classified information related to such areas or operations; or

28 USC 2671 *et*
seq.

“(E) to require indemnification pursuant to the provisions of chapter 171 of title 28, United States Code (commonly referred to as the Federal Tort Claims Act), or section 170 of the Atomic Energy Act of 1954 (42 U.S.C. 2210) (commonly referred to as the Price-Anderson Act), whichever is applicable.

Prohibition.

“(4) **FEDERAL AUTHORITY.**—Except as expressly provided in this Act, nothing contained in this Act or any compact may be construed to limit the applicability of any Federal law or to diminish or otherwise impair the jurisdiction of any Federal agency, or to alter, amend, or otherwise affect any Federal law governing the judicial review of any action taken pursuant to any compact.

Prohibition.

“(5) **STATE AUTHORITY PRESERVED.**—Except as expressly provided in this Act, nothing contained in this Act expands, diminishes, or otherwise affects State law.

Prohibition.

“(c) **RESTRICTED USE OF REGIONAL DISPOSAL FACILITIES.**—Any authority in a compact to restrict the use of the regional disposal facilities under the compact to the disposal of low-level radioactive waste generated within the compact region shall not take effect before each of the following occurs:

“(1) January 1, 1986; and

“(2) the Congress by law consents to the compact.

“(d) **CONGRESSIONAL REVIEW.**—Each compact shall provide that every 5 years after the compact has taken effect the Congress may by law withdraw its consent.

42 USC 2021e.

“SEC. 5. LIMITED AVAILABILITY OF CERTAIN REGIONAL DISPOSAL FACILITIES DURING TRANSITION AND LICENSING PERIODS.

“(a) AVAILABILITY OF DISPOSAL CAPACITY.—

“(1) PRESSURIZED-WATER AND BOILING WATER REACTORS.—During the seven-year period beginning January 1, 1986 and ending December 31, 1992, subject to the provisions of subsections (b) through (g), each State in which there is located a regional disposal facility referred to in paragraphs (1) through (3) of subsection (b) shall make disposal capacity available for low-level radioactive waste generated by pressurized water and boiling water commercial nuclear power reactors in accordance with the allocations established in subsection (c).

“(2) OTHER SOURCES OF LOW-LEVEL RADIOACTIVE WASTE.—During the seven-year period beginning January 1, 1986 and ending December 31, 1992, subject to the provisions of subsections (b) through (g), each State in which there is located a regional disposal facility referred to in paragraphs (1) through (3) of subsection (b) shall make disposal capacity available for low-level radioactive waste generated by any source not referred to in paragraph (1).

“(3) ALLOCATION OF DISPOSAL CAPACITY.—

“(A) During the seven-year period beginning January 1, 1986 and ending December 31, 1992, low-level radioactive waste generated within a sited compact region shall be accorded priority under this section in the allocation of available disposal capacity at a regional disposal facility

referred to in paragraphs (1) through (3) of subsection (b) and located in the sited compact region in which such waste is generated.

"(B) Any State in which a regional disposal facility referred to in paragraphs (1) through (3) of subsection (b) is located may, subject to the provisions of its compact, prohibit the disposal at such facility of low-level radioactive waste generated outside of the compact region if the disposal of such waste in any given calendar year, together with all other low-level radioactive waste disposed of at such facility within that same calendar year, would result in that facility disposing of a total annual volume of low-level radioactive waste in excess of 100 per centum of the average annual volume for such facility designated in subsection (b): *Provided, however,* That in the event that all three States in which regional disposal facilities referred to in paragraphs (1) through (3) of subsection (b) act to prohibit the disposal of low-level radioactive waste pursuant to this subparagraph, each such State shall, in accordance with any applicable procedures of its compact, permit, as necessary, the disposal of additional quantities of such waste in increments of 10 per centum of the average annual volume for each such facility designated in subsection (b).

"(C) Nothing in this paragraph shall require any disposal facility or State referred to in paragraphs (1) through (3) of subsection (b) to accept for disposal low-level radioactive waste in excess of the total amounts designated in subsection (b).

Prohibition.

"(4) **CESSATION OF OPERATION OF LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY.**—No provision of this section shall be construed to obligate any State referred to in paragraphs (1) through (3) of subsection (b) to accept low-level radioactive waste from any source in the event that the regional disposal facility located in such State ceases operations.

Prohibition.

"(b) **LIMITATIONS.**—The availability of disposal capacity for low-level radioactive waste from any source shall be subject to the following limitations:

"(1) **BARNWELL, SOUTH CAROLINA.**—The State of South Carolina, in accordance with the provisions of its compact, may limit the volume of low-level radioactive waste accepted for disposal at the regional disposal facility located at Barnwell, South Carolina to a total of 8,400,000 cubic feet of low-level radioactive waste during the 7-year period beginning January 1, 1986, and ending December 31, 1992 (as based on an average annual volume of 1,200,000 cubic feet of low-level radioactive waste).

"(2) **RICHLAND, WASHINGTON.**—The State of Washington, in accordance with the provisions of its compact, may limit the volume of low-level radioactive waste accepted for disposal at the regional disposal facility located at Richland, Washington to a total of 9,800,000 cubic feet of low-level radioactive waste during the 7-year period beginning January 1, 1986, and ending December 31, 1992 (as based on an average annual volume of 1,400,000 cubic feet of low-level radioactive waste).

"(3) **BEATTY, NEVADA.**—The State of Nevada, in accordance with the provisions of its compact, may limit the volume of low-level radioactive waste accepted for disposal at the regional disposal facility located at Beatty, Nevada to a total of 1,400,000

cubic feet of low-level radioactive waste during the 7-year period beginning January 1, 1986, and ending December 31, 1992 (as based on an average annual volume of 200,000 cubic feet of low-level radioactive waste).

“(c) COMMERCIAL NUCLEAR POWER REACTOR ALLOCATIONS.—

“(1) AMOUNT.—Subject to the provisions of subsections (a) through (g) each commercial nuclear power reactor shall upon request receive an allocation of low-level radioactive waste disposal capacity (in cubic feet) at the facilities referred to in subsection (b) during the 4-year transition period beginning January 1, 1986, and ending December 31, 1989, and during the 3-year licensing period beginning January 1, 1990, and ending December 31, 1992, in an amount calculated by multiplying the appropriate number from the following table by the number of months remaining in the applicable period as determined under paragraph (2).

“Reactor Type	4-year Transition Period		3-year Licensing Period	
	In Sited Region	All Other Locations	In Sited Region	All Other Locations
PWR _____	1027	871	934	685
BWR _____	2300	1951	2091	1533

“(2) METHOD OF CALCULATION.—For purposes of calculating the aggregate amount of disposal capacity available to a commercial nuclear power reactor under this subsection, the number of months shall be computed beginning with the first month of the applicable period, or the sixteenth month after receipt of a full power operating license, whichever occurs later.

“(3) UNUSED ALLOCATIONS.—Any unused allocation under paragraph (1) received by a reactor during the transition period or the licensing period may be used at any time after such reactor receives its full power license or after the beginning of the pertinent period, whichever is later, but not in any event after December 31, 1992, or after commencement of operation of a regional disposal facility in the compact region or State in which such reactor is located, whichever occurs first.

“(4) TRANSFERABILITY.—Any commercial nuclear power reactor in a State or compact region that is in compliance with the requirements of subsection (e) may assign any disposal capacity allocated to it under this subsection to any other person in each State or compact region. Such assignment may be for valuable consideration and shall be in writing, copies of which shall be filed at the affected compact commissions and States, along with the assignor's unconditional written waiver of the disposal capacity being assigned.

“(5) UNUSUAL VOLUMES.—

“(A) The Secretary may, upon petition by the owner or operator of any commercial nuclear power reactor, allocate to such reactor disposal capacity in excess of the amount calculated under paragraph (1) if the Secretary finds and states in writing his reasons for so finding that making additional capacity available for such reactor through this

paragraph is required to permit unusual or unexpected operating, maintenance, repair or safety activities.

"(B) The Secretary may not make allocations pursuant to subparagraph (A) that would result in the acceptance for disposal of more than 800,000 cubic feet of low-level radioactive waste or would result in the total of the allocations made pursuant to this subsection exceeding 11,900,000 cubic feet over the entire seven-year interim access period.

Prohibition.

"(6) LIMITATION.—During the seven-year interim access period referred to in subsection (a), the disposal facilities referred to in subsection (b) shall not be required to accept more than 11,900,000 cubic feet of low-level radioactive waste generated by commercial nuclear power reactors.

Prohibition.

"(d)(1) SURCHARGES.—The disposal of any low-level radioactive waste under this section (other than low-level radioactive waste generated in a sited compact region) may be charged a surcharge by the State in which the applicable regional disposal facility is located, in addition to the fees and surcharges generally applicable for disposal of low-level radioactive waste in the regional disposal facility involved. Except as provided in subsection (e)(2), such surcharges shall not exceed—

Prohibition.

"(A) in 1986 and 1987, \$10 per cubic foot of low-level radioactive waste;

"(B) in 1988 and 1989, \$20 per cubic foot of low-level radioactive waste; and

"(C) in 1990, 1991, and 1992, \$40 per cubic foot of low-level radioactive waste.

"(2) MILESTONE INCENTIVES.—

"(A) ESCROW ACCOUNT.—Twenty-five per centum of all surcharge fees received by a State pursuant to paragraph (1) during the seven-year period referred to in subsection (a) shall be transferred on a monthly basis to an escrow account held by the Secretary. The Secretary shall deposit all funds received in a special escrow account. The funds so deposited shall not be the property of the United States. The Secretary shall act as trustee for such funds and shall invest them in interest-bearing United States Government Securities with the highest available yield. Such funds shall be held by the Secretary until—

"(i) paid or repaid in accordance with subparagraph (B) or (C); or

"(ii) paid to the State collecting such fees in accordance with subparagraph (F).

"(B) PAYMENTS.—

"(i) JULY 1, 1986.—The twenty-five per centum of any amount collected by a State under paragraph (1) for low-level radioactive waste disposed of under this section during the period beginning on the date of enactment of the Low-Level Radioactive Waste Policy Amendments Act of 1985 and ending June 30, 1986, and transferred to the Secretary under subparagraph (A), shall be paid by the Secretary in accordance with subparagraph (D) if the milestone described in subsection (e)(1)(A) is met by the State in which such waste originated.

Ante, p. 1842.

"(ii) JANUARY 1, 1988.—The twenty-five per centum of any amount collected by a State under paragraph (1) for low-level radioactive waste disposed of under this section during the period beginning July 1, 1986 and ending Decem-

ber 31, 1987, and transferred to the Secretary under subparagraph (A), shall be paid by the Secretary in accordance with subparagraph (D) if the milestone described in subsection (e)(1)(B) is met by the State in which such waste originated (or its compact region, where applicable).

“(iii) JANUARY 1, 1990.—The twenty-five per centum of any amount collected by a State under paragraph (1) for low-level radioactive waste disposed of under this section during the period beginning January 1, 1988 and ending December 31, 1989, and transferred to the Secretary under subparagraph (A), shall be paid by the Secretary in accordance with subparagraph (D) if the milestone described in subsection (e)(1)(C) is met by the State in which such waste originated (or its compact region, where applicable).

“(iv) The twenty-five per centum of any amount collected by a State under paragraph (1) for low-level radioactive waste disposed of under this section during the period beginning January 1, 1990 and ending December 31, 1992, and transferred to the Secretary under subparagraph (A), shall be paid by the Secretary in accordance with subparagraph (D) if, by January 1, 1993, the State in which such waste originated (or its compact region, where applicable) is able to provide for the disposal of all low-level radioactive waste generated within such State or compact region.

“(C) FAILURE TO MEET JANUARY 1, 1993 DEADLINE.—If, by January 1, 1993, a State (or, where applicable, a compact region) in which low-level radioactive waste is generated is unable to provide for the disposal of all such waste generated within such State or compact region—

“(i) each State in which such waste is generated, upon the request of the generator or owner of the waste, shall take title to the waste, shall be obligated to take possession of the waste, and shall be liable for all damages directly or indirectly incurred by such generator or owner as a consequence of the failure of the State to take possession of the waste as soon after January 1, 1993 as the generator or owner notifies the State that the waste is available for shipment; or

“(ii) if such State elects not to take title to, take possession of, and assume liability for such waste, pursuant to clause (i), twenty-five per centum of any amount collected by a State under paragraph (1) for low-level radioactive waste disposed of under this section during the period beginning January 1, 1990 and ending December 31, 1992 shall be repaid, with interest, to each generator from whom such surcharge was collected. Repayments made pursuant to this clause shall be made on a monthly basis, with the first such repayment beginning on February 1, 1993, in an amount equal to one thirty-sixth of the total amount required to be repaid pursuant to this clause, and shall continue until the State (or, where applicable, compact region) in which such low-level radioactive waste is generated is able to provide for the disposal of all such waste generated within such State or compact region or until January 1, 1996, whichever is earlier.

If a State in which low-level radioactive waste is generated elects to take title to, take possession of, and assume liability for

such waste pursuant to clause (i), such State shall be paid such amounts as are designated in subparagraph (B)(iv). If a State (or, where applicable, a compact region) in which low-level radioactive waste is generated provides for the disposal of such waste at any time after January 1, 1993 and prior to January 1, 1996, such State (or, where applicable, compact region) shall be paid in accordance with subparagraph (D) a lump sum amount equal to twenty-five per centum of any amount collected by a State under paragraph (1): *Provided, however,* That such payment shall be adjusted to reflect the remaining number of months between January 1, 1993 and January 1, 1996 for which such State (or, where applicable, compact region) provides for the disposal of such waste. If a State (or, where applicable, a compact region) in which low-level radioactive waste is generated is unable to provide for the disposal of all such waste generated within such State or compact region by January 1, 1996, each State in which such waste is generated, upon the request of the generator or owner of the waste, shall take title to the waste, be obligated to take possession of the waste, and shall be liable for all damages directly or indirectly incurred by such generator or owner as a consequence of the failure of the State to take possession of the waste as soon after January 1, 1996, as the generator or owner notifies the State that the waste is available for shipment.

“(D) RECIPIENTS OF PAYMENTS.—The payments described in subparagraphs (B) and (C) shall be paid within thirty days after the applicable date—

“(i) if the State in which such waste originated is not a member of a compact region, to such State;

“(ii) if the State in which such waste originated is a member of the compact region, to the compact commission serving such State.

“(E) USES OF PAYMENTS.—

“(i) LIMITATIONS.—Any amount paid under subparagraphs (B) or (C) may only be used to—

“(I) establish low-level radioactive waste disposal facilities;

“(II) mitigate the impact of low-level radioactive waste disposal facilities on the host State;

“(III) regulate low-level radioactive waste disposal facilities; or

“(IV) ensure the decommissioning, closure, and care during the period of institutional control of low-level radioactive waste disposal facilities.

“(ii) REPORTS.—

“(I) RECIPIENT.—Any State or compact commission receiving a payment under subparagraphs (B) or (C) shall, on December 31 of each year in which any such funds are expended, submit a report to the Department of Energy itemizing any such expenditures.

“(II) DEPARTMENT OF ENERGY.—Not later than six months after receiving the reports under subclause (I), the Secretary shall submit to the Congress a summary of all such reports that shall include an assessment of the compliance of each such State or compact commission with the requirements of clause (i).

Reports.

"(F) **PAYMENT TO STATES.**—Any amount collected by a State under paragraph (1) that is placed in escrow under subparagraph (A) and not paid to a State or compact commission under subparagraphs (B) and (C) or not repaid to a generator under subparagraph (C) shall be paid from such escrow account to such State collecting such payment under paragraph (1). Such payment shall be made not later than 30 days after a determination of ineligibility for a refund is made.

Prohibition.

"(G) **PENALTY SURCHARGES.**—No rebate shall be made under this subsection of any surcharge or penalty surcharge paid during a period of noncompliance with subsection (e)(1).

"(e) **REQUIREMENTS FOR ACCESS TO REGIONAL DISPOSAL FACILITIES.**—

"(1) **REQUIREMENTS FOR NON-SITED COMPACT REGIONS AND NON-MEMBER STATES.**—Each non-sited compact region, or State that is not a member of a compact region that does not have an operating disposal facility, shall comply with the following requirements:

"(A) By July 1, 1986, each such non-member State shall ratify compact legislation or, by the enactment of legislation or the certification of the Governor, indicate its intent to develop a site for the location of a low-level radioactive waste disposal facility within such State.

"(B) **BY JANUARY 1, 1988.**—

"(i) each non-sited compact region shall identify the State in which its low-level radioactive waste disposal facility is to be located, or shall have selected the developer for such facility and the site to be developed, and each compact region or the State in which its low-level radioactive waste disposal facility is to be located shall develop a siting plan for such facility providing detailed procedures and a schedule for establishing a facility location and preparing a facility license application and shall delegate authority to implement such plan;

"(ii) each non-member State shall develop a siting plan providing detailed procedures and a schedule for establishing a facility location and preparing a facility license application for a low-level radioactive waste disposal facility and shall delegate authority to implement such plan; and

"(iii) The siting plan required pursuant to this paragraph shall include a description of the optimum way to attain operation of the low-level radioactive waste disposal facility involved, within the time period specified in this Act. Such plan shall include a description of the objectives and a sequence of deadlines for all entities required to take action to implement such plan, including, to the extent practicable, an identification of the activities in which a delay in the start, or completion, of such activities will cause a delay in beginning facility operation. Such plan shall also identify, to the extent practicable, the process for (1) screening for broad siting areas; (2) identifying and evaluating specific candidate sites; and (3) characterizing the preferred site(s), completing all necessary environmental assessments, and preparing a license application for

submission to the Nuclear Regulatory Commission or an Agreement State.

“(C) BY JANUARY 1, 1990.—

“(i) a complete application (as determined by the Nuclear Regulatory Commission or the appropriate agency of an agreement State) shall be filed for a license to operate a low-level radioactive waste disposal facility within each non-sited compact region or within each non-member State; or

“(ii) the Governor (or, for any State without a Governor, the chief executive officer) of any State that is not a member of a compact region in compliance with clause (i), or has not complied with such clause by its own actions, shall provide a written certification to the Nuclear Regulatory Commission, that such State will be capable of providing for, and will provide for, the storage, disposal, or management of any low-level radioactive waste generated within such State and requiring disposal after December 31, 1992, and include a description of the actions that will be taken to ensure that such capacity exists.

“(D) By January 1, 1992, a complete application (as determined by the Nuclear Regulatory Commission or the appropriate agency of an agreement State) shall be filed for a license to operate a low-level radioactive waste disposal facility within each non-sited compact region or within each non-member State.

“(E) The Nuclear Regulatory Commission shall transmit any certification received under subparagraph (C) to the Congress and publish any such certification in the Federal Register.

Federal Register,
publication.

“(F) Any State may, subject to all applicable provisions, if any, of any applicable compact, enter into an agreement with the compact commission of a region in which a regional disposal facility is located to provide for the disposal of all low-level radioactive waste generated within such State, and, by virtue of such agreement, may, with the approval of the State in which the regional disposal facility is located, be deemed to be in compliance with subparagraphs (A), (B), (C), and (D).

Contracts.

“(2) PENALTIES FOR FAILURE TO COMPLY.—

“(A) BY JULY 1, 1986.—If any State fails to comply with subparagraph (1)(A)—

“(i) any generator of low-level radioactive waste within such region or non-member State shall, for the period beginning July 1, 1986, and ending December 31, 1986, be charged 2 times the surcharge otherwise applicable under subsection (d); and

“(ii) on or after January 1, 1987, any low-level radioactive waste generated within such region or non-member State may be denied access to the regional disposal facilities referred to in paragraphs (1) through (3) of subsection (b).

“(B) BY JANUARY 1, 1988.—If any non-sited compact region or non-member State fails to comply with paragraph (1)(B)—

“(i) any generator of low-level radioactive waste within such region or non-member State shall—

“(I) for the period beginning January 1, 1988, and ending June 30, 1988, be charged 2 times the surcharge otherwise applicable under subsection (d); and

“(II) for the period beginning July 1, 1988, and ending December 31, 1988, be charged 4 times the surcharge otherwise applicable under subsection (d); and

“(ii) on or after January 1, 1989, any low-level radioactive waste generated within such region or non-member State may be denied access to the regional disposal facilities referred to in paragraphs (1) through (3) of subsection (b).

“(C) BY JANUARY 1, 1990.—If any non-sited compact region or non-member State fails to comply with paragraph (1)(C), any low-level radioactive waste generated within such region or non-member State may be denied access to the regional disposal facilities referred to in paragraphs (1) through (3) of subsection (b).

“(D) BY JANUARY 1, 1992.—If any non-sited compact region or non-member State fails to comply with paragraph (1)(D), any generator of low-level radioactive waste within such region or non-member State shall, for the period beginning January 1, 1992 and ending upon the filing of the application described in paragraph (1)(D), be charged 3 times the surcharge otherwise applicable under subsection (d).

Prohibition.

“(3) DENIAL OF ACCESS.—No denial or suspension of access to a regional disposal facility under paragraph (2) may be based on the source, class, or type of low-level radioactive waste.

“(4) RESTORATION OF SUSPENDED ACCESS; PENALTIES FOR FAILURE TO COMPLY.—Any access to a regional disposal facility that is suspended under paragraph (2) shall be restored after the non-sited compact region or non-member State involved complies with such requirement. Any payment of surcharge penalties pursuant to paragraph (2) for failure to comply with the requirements of subsection (e) shall be terminated after the non-sited compact region or non-member State involved complies with such requirements.

Termination.

“(f)(1) ADMINISTRATION.—Each State and compact commission in which a regional disposal facility referred to in paragraphs (1) through (3) of subsection (b) is located shall have authority—

“(A) to monitor compliance with the limitations, allocations, and requirements established in this section; and

“(B) to deny access to any non-Federal low-level radioactive waste disposal facilities within its borders to any low-level radioactive waste that—

“(i) is in excess of the limitations or allocations established in this section; or

“(ii) is not required to be accepted due to the failure of a compact region or State to comply with the requirements of subsection (e)(1).

“(2) AVAILABILITY OF INFORMATION DURING INTERIM ACCESS PERIOD.—

“(A) The States of South Carolina, Washington, and Nevada may require information from disposal facility operators, generators, intermediate handlers, and the Department of Energy that is reasonably necessary to monitor the availability of disposal capacity, the use and assignment of allocations and the applicability of surcharges.

South Carolina.
Washington.
Nevada.

“(B) The States of South Carolina, Washington, and Nevada may, after written notice followed by a period of at least 30 days, deny access to disposal capacity to any generator or intermediate handler who fails to provide information under subparagraph (A).

South Carolina.
Washington.
Nevada.

“(C) PROPRIETARY INFORMATION.—

“(i) Trade secrets, proprietary and other confidential information shall be made available to a State under this subsection upon request only if such State—

“(I) consents in writing to restrict the dissemination of the information to those who are directly involved in monitoring under subparagraph (A) and who have a need to know;

“(II) accepts liability for wrongful disclosure; and

“(III) demonstrates that such information is essential to such monitoring.

“(ii) The United States shall not be liable for the wrongful disclosure by any individual or State of any information provided to such individual or State under this subsection.

“(iii) Whenever any individual or State has obtained possession of information under this subsection, the individual shall be subject to the same provisions of law with respect to the disclosure of such information as would apply to an officer or employee of the United States or of any department or agency thereof and the State shall be subject to the same provisions of law with respect to the disclosure of such information as would apply to the United States or any department or agency thereof. No State or State officer or employee who receives trade secrets, proprietary information, or other confidential information under this Act may be required to disclose such information under State law.

Prohibition.
Government
organization and
employees.
Commerce and
trade.

“(g) NONDISCRIMINATION.—Except as provided in subsections (b) through (e), low-level radioactive waste disposed of under this section shall be subject without discrimination to all applicable legal requirements of the compact region and State in which the disposal facility is located as if such low-level radioactive waste were generated within such compact region.

“SEC. 6. EMERGENCY ACCESS.

42 USC 2021f.

“(a) IN GENERAL.—The Nuclear Regulatory Commission may grant emergency access to any regional disposal facility or non-Federal disposal facility within a State that is not a member of a compact for specific low-level radioactive waste, if necessary to eliminate an immediate and serious threat to the public health and safety or the common defense and security. The procedure for granting emergency access shall be as provided in this section.

Health.
Safety.
Defense and
national
security.

“(b) REQUEST FOR EMERGENCY ACCESS.—Any generator of low-level radioactive waste, or any Governor (or, for any State without a Governor, the chief executive officer of the State) on behalf of any generator or generators located in his or her State, may request that

the Nuclear Regulatory Commission grant emergency access to a regional disposal facility or a non-Federal disposal facility within a State that is not a member of a compact for specific low-level radioactive waste. Any such request shall contain any information and certifications the Nuclear Regulatory Commission may require.

“(c) DETERMINATION OF NUCLEAR REGULATORY COMMISSION.—

“(1) REQUIRED DETERMINATION.—Not later than 45 days after receiving a request under subsection (b), the Nuclear Regulatory Commission shall determine whether—

“(A) emergency access is necessary because of an immediate and serious threat to the public health and safety or the common defense and security; and

“(B) the threat cannot be mitigated by any alternative consistent with the public health and safety, including storage of low-level radioactive waste at the site of generation or in a storage facility obtaining access to a disposal facility by voluntary agreement, purchasing disposal capacity available for assignment pursuant to section 5(c) or ceasing activities that generate low-level radioactive waste.

“(2) REQUIRED NOTIFICATION.—If the Nuclear Regulatory Commission makes the determinations required in paragraph (1) in the affirmative, it shall designate an appropriate non-Federal disposal facility or facilities, and notify the Governor (or chief executive officer) of the State in which such facility is located and the appropriate compact commission that emergency access is required. Such notification shall specifically describe the low-level radioactive waste as to source, physical and radiological characteristics, and the minimum volume and duration, not exceeding 180 days, necessary to alleviate the immediate threat to public health and safety or the common defense and security. The Nuclear Regulatory Commission shall also notify the Governor (or chief executive officer) of the State in which the low-level radioactive waste requiring emergency access was generated that emergency access has been granted and that, pursuant to subsection (e), no extension of emergency access may be granted absent diligent State action during the period of the initial grant.

“(d) TEMPORARY EMERGENCY ACCESS.—Upon determining that emergency access is necessary because of an immediate and serious threat to the public health and safety or the common defense and security, the Nuclear Regulatory Commission may at its discretion grant temporary emergency access, pending its determination whether the threat could be mitigated by any alternative consistent with the public health and safety. In granting access under this subsection, the Nuclear Regulatory Commission shall provide the same notification and information required under subsection (c). Absent a determination that no alternative consistent with the public health and safety would mitigate the threat, access granted under this subsection shall expire 45 days after the granting of temporary emergency access under this subsection.

“(e) EXTENSION OF EMERGENCY ACCESS.—The Nuclear Regulatory Commission may grant one extension of emergency access beyond the period provided in subsection (c), if it determines that emergency access continues to be necessary because of an immediate and serious threat to the public health and safety or the common defense and security that cannot be mitigated by any alternative consistent with the public health and safety, and that the generator of low-

Health.
Safety.
Defense and
national
security.

Ante, p. 1846.

Prohibition.

Health.
Safety.
Defense and
national
security.

Health.
Safety.
Defense and
national
security.

level radioactive waste granted emergency access and the State in which such low-level radioactive waste was generated have diligently though unsuccessfully acted during the period of the initial grant to eliminate the need for emergency access. Any extension granted under this subsection shall be for the minimum volume and duration the Nuclear Regulatory Commission finds necessary to eliminate the immediate threat to public health and safety or the common defense and security, and shall not in any event exceed 180 days.

“(f) **RECIPROCAL ACCESS.**—Any compact region or State not a member of a compact that provides emergency access to non-Federal disposal facilities within its borders shall be entitled to reciprocal access to any subsequently operating non-Federal disposal facility that serves the State or compact region in which low-level radioactive waste granted emergency access was generated. The compact commission or State having authority to approve importation of low-level radioactive waste to the disposal facility to which emergency access was granted shall designate for reciprocal access an equal volume of low-level radioactive waste having similar characteristics to that provided emergency access.

“(g) **APPROVAL BY COMPACT COMMISSION.**—Any grant of access under this section shall be submitted to the compact commission for the region in which the designated disposal facility is located for such approval as may be required under the terms of its compact. Any such compact commission shall act to approve emergency access not later than 15 days after receiving notification from the Nuclear Regulatory Commission, or reciprocal access not later than 15 days after receiving notification from the appropriate authority under subsection (f).

“(h) **LIMITATIONS.**—No State shall be required to provide emergency or reciprocal access to any regional disposal facility within its borders for low-level radioactive waste not meeting criteria established by the license or license agreement of such facility, or in excess of the approved capacity of such facility, or to delay the closing of any such facility pursuant to plans established before receiving a request for emergency or reciprocal access. No State shall, during any 12-month period, be required to provide emergency or reciprocal access to any regional disposal facility within its borders for more than 20 percent of the total volume of low-level radioactive waste accepted for disposal at such facility during the previous calendar year.

“(i) **VOLUME REDUCTION AND SURCHARGES.**—Any low-level radioactive waste delivered for disposal under this section shall be reduced in volume to the maximum extent practicable and shall be subject to surcharges established in this Act.

“(j) **DEDUCTION FROM ALLOCATION.**—Any volume of low-level radioactive waste granted emergency or reciprocal access under this section, if generated by any commercial nuclear power reactor, shall be deducted from the low-level radioactive waste volume allocable under section 5(c).

“(k) **AGREEMENT STATES.**—Any agreement under section 274 of the Atomic Energy Act of 1954 (42 U.S.C. 2021) shall not be applicable to the determinations of the Nuclear Regulatory Commission under this section.

Prohibitions.

Ante, p. 1846.
Prohibition.

42 USC 2021g.

"SEC. 7. RESPONSIBILITIES OF THE DEPARTMENT OF ENERGY.

"(a) FINANCIAL AND TECHNICAL ASSISTANCE.—The Secretary shall, to the extent provided in appropriations Act, provide to those compact regions, host States, and nonmember States determined by the Secretary to require assistance for purposes of carrying out this Act—

Science and
technology.
Transportation.
Health.
Safety.

"(1) continuing technical assistance to assist them in fulfilling their responsibilities under this Act. Such technical assistance shall include, but not be limited to, technical guidelines for site selection, alternative technologies for low-level radioactive waste disposal, volume reduction options, management techniques to reduce low-level waste generation, transportation practices for shipment of low-level wastes, health and safety considerations in the storage, shipment and disposal of low-level radioactive wastes, and establishment of a computerized database to monitor the management of low-level radioactive wastes; and

"(2) through the end of fiscal year 1993, financial assistance to assist them in fulfilling their responsibilities under this Act.

Science and
technology.
Transportation.

"(b) REPORTS.—The Secretary shall prepare and submit to the Congress on an annual basis a report which (1) summarizes the progress of low-level waste disposal siting and licensing activities within each compact region, (2) reviews the available volume reduction technologies, their applications, effectiveness, and costs on a per unit volume basis, (3) reviews interim storage facility requirements, costs, and usage, (4) summarizes transportation requirements for such wastes on an inter- and intra-regional basis, (5) summarizes the data on the total amount of low-level waste shipped for disposal on a yearly basis, the proportion of such wastes subjected to volume reduction, the average volume reduction attained, and the proportion of wastes stored on an interim basis, and (6) projects the interim storage and final disposal volume requirements anticipated for the following year, on a regional basis.

42 USC 2021h.

"SEC. 8. ALTERNATIVE DISPOSAL METHODS.*Ante*, p. 1842.

"(a) Not later than 12 months after the date of enactment of the Low-Level Radioactive Waste Policy Amendments Act of 1985, the Nuclear Regulatory Commission shall, in consultation with the States and other interested persons, identify methods for the disposal of low-level radioactive waste other than shallow land burial, and establish and publish technical guidance regarding licensing of facilities that use such methods.

"(b) Not later than 24 months after the date of enactment of the Low-Level Radioactive Waste Policy Amendments Act of 1985, the Commission shall, in consultation with the States and other interested persons, identify and publish all relevant technical information regarding the methods identified pursuant to subsection (a) that a State or compact must provide to the Commission in order to pursue such methods, together with the technical requirements that such facilities must meet, in the judgment of the Commission, if pursued as an alternative to shallow land burial. Such technical information and requirements shall include, but need not be limited to, site suitability, site design, facility operation, disposal site closure, and environmental monitoring, as necessary to meet the performance objectives established by the Commission for a licensed low-level radioactive waste disposal facility. The Commis-

sion shall specify and publish such requirements in a manner and form deemed appropriate by the Commission.

"SEC. 9. LICENSING REVIEW AND APPROVAL.

42 USC 2021i.

"In order to ensure the timely development of new low-level radioactive waste disposal facilities, the Nuclear Regulatory Commission or, as appropriate, agreement States, shall consider an application for a disposal facility license in accordance with the laws applicable to such application, except that the Commission and the agreement state shall—

"(1) not later than 12 months after the date of enactment of the Low-Level Radioactive Waste Policy Amendments Act of 1985, establish procedures and develop the technical capability for processing applications for such licenses;

Ante, p. 1842.

"(2) to the extent practicable, complete all activities associated with the review and processing of any application for such a license (except for public hearings) no later than 15 months after the date of receipt of such application; and

"(3) to the extent practicable, consolidate all required technical and environmental reviews and public hearings.

"SEC. 10. RADIOACTIVE WASTE BELOW REGULATORY CONCERN.

"(a) Not later than 6 months after the date of enactment of the Low-Level Radioactive Waste Policy Amendments Act of 1985, the Commission shall establish standards and procedures, pursuant to existing authority, and develop the technical capability for considering and acting upon petitions to exempt specific radioactive waste streams from regulation by the Commission due to the presence of radionuclides in such waste streams in sufficiently low concentrations or quantities as to be below regulatory concern.

"(b) The standards and procedures established by the Commission pursuant to subsection (a) shall set forth all information required to be submitted to the Commission by licensees in support of such petitions, including, but not limited to—

"(1) a detailed description of the waste materials, including their origin, chemical composition, physical state, volume, and mass; and

"(2) the concentration or contamination levels, half-lives, and identities of the radionuclides present.

Health.
Safety.
Regulation.

Such standards and procedures shall provide that, upon receipt of a petition to exempt a specific radioactive waste stream from regulation by the Commission, the Commission shall determine in an expeditious manner whether the concentration or quantity of radionuclides present in such waste stream requires regulation by the Commission in order to protect the public health and safety. Where the Commission determines that regulation of a radioactive waste stream is not necessary to protect the public health and safety, the Commission shall take such steps as may be necessary, in an expeditious manner, to exempt the disposal of such radioactive waste from regulation by the Commission."

**10 CFT 20 Nuclear Regulatory Commission
Standards for Protection Against Radiation**

10 CFT Part 20

Nuclear Regulatory Commission

Standards for Protection Against Radiation

Nuclear Regulatory Commission

Pt. 20

PART 20—STANDARDS FOR PROTECTION AGAINST RADIATION

GENERAL PROVISIONS

- Sec.
- 20.1 Purpose.
 - 20.2 Scope.
 - 20.3 Definitions.
 - 20.4 Units of radiation dose.
 - 20.5 Units of radioactivity.
 - 20.6 Interpretations.
 - 20.7 Communications.
 - 20.8 Information collection requirements:
OMB approval.

PERMISSIBLE DOSES, LEVELS AND CONCENTRATIONS

- 20.101 Radiation dose standards for individuals in restricted areas.
- 20.102 Determination of prior dose.
- 20.103 Exposure of individuals to concentrations of radioactive materials in air in restricted areas.
- 20.104 Exposure of minors.
- 20.105 Permissible levels of radiation in unrestricted areas.
- 20.106 Radioactivity in effluents to unrestricted areas.
- 20.107 Medical diagnosis and therapy.
- 20.108 Orders requiring furnishing of bioassay services.

PRECAUTIONARY PROCEDURES

- 20.201 Surveys.
- 20.202 Personnel monitoring.

- Sec.
 20.203 Caution signs, labels, signals and controls.
 20.204 Same: Exceptions.
 20.205 Procedures for picking up, receiving, and opening packages.
 20.206 Instruction of personnel.
 20.207 Storage and control of licensed materials in unrestricted areas.

WASTE DISPOSAL

- 20.301 General requirement.
 20.302 Method for obtaining approval of proposed disposal procedures.
 20.303 Disposal by release into sanitary sewerage systems.
 20.305 Treatment or disposal by incineration.
 20.306 Disposal of specific wastes.
 20.311 Transfer for disposal and manifests.

RECORDS, REPORTS, AND NOTIFICATION

- 20.401 Records of surveys, radiation monitoring, and disposal.
 20.402 Reports of theft or loss of licensed material.
 20.403 Notifications of incidents.
 20.404 (Reserved)
 20.405 Reports of overexposures and excessive levels and concentrations.
 20.406 (Reserved)
 20.407 Personnel monitoring reports.
 20.408 Reports of personnel monitoring on termination of employment or work.
 20.409 Notifications and reports to individuals.

EXCEPTIONS AND ADDITIONAL REQUIREMENTS

- 20.501 Applications for exemptions.
 20.502 Additional requirements.

ENFORCEMENT

- 20.601 Violations.

APPENDIX A TO §§ 20.1-20.601—PROTECTION FACTORS FOR RESPIRATORS

APPENDIX B TO §§ 20.1-20.601—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND

APPENDIX C TO §§ 20.1-20.601

APPENDIX D TO §§ 20.1-20.601—UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICES

REGULATIONS MANDATORY AS OF JANUARY 1, 1993 WITH EARLIER COMPLIANCE ENCOURAGED

Subpart A—General Provisions

- 20.1001 Purpose.
 20.1002 Scope.
 20.1003 Definitions.
 20.1004 Units of radiation dose.
 20.1005 Units of radioactivity.
 20.1006 Interpretations.
 20.1007 Communications.

Sec.

- 20.1008 Implementation.
 20.1009 Reporting, recording, and application requirements: OMB approval.

Subpart B—Radiation Protection Programs

- 20.1101 Radiation protection programs.

Subpart C—Occupational Dose Limits

- 20.1201 Occupational dose limits for adults.
 20.1202 Compliance with requirements for summation of external and internal doses.
 20.1203 Determination of external dose from airborne radioactive material.
 20.1204 Determination of internal exposure.
 20.1205 (Reserved)
 20.1206 Planned special exposures.
 20.1207 Occupational dose limits for minors.
 20.1208 Dose to an embryo/fetus.

Subpart D—Radiation Dose Limits for Individual Members of the Public

- 20.1301 Dose limits for individual members of the public.
 20.1302 Compliance with dose limits for individual members of the public.

Subpart E—(Reserved)

Subpart F—Surveys and Monitoring

- 20.1501 General.
 20.1502 Conditions requiring individual monitoring of external and internal occupational dose.

Subpart G—Control of Exposure From External Sources in Restricted Areas

- 20.1601 Control of access to high radiation areas.
 20.1602 Control of access to very high radiation areas.
 20.1603 Control of access to very high radiation areas—irradiators.

Subpart H—Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas

- 20.1701 Use of process or other engineering controls.
 20.1702 Use of other controls.
 20.1703 Use of individual respiratory protection equipment.
 20.1704 Further restrictions on the use of respiratory protection equipment.

Subpart I—Storage and Control of Licensed Material

- 20.1801 Security of stored material.
- 20.1802 Control of material not in storage.

Subpart J—Precautionary Procedures

- 20.1901 Caution signs.
- 20.1902 Posting requirements.
- 20.1903 Exceptions to posting requirements.
- 20.1904 Labeling containers.
- 20.1905 Exemptions to labeling requirements.
- 20.1906 Procedures for receiving and opening packages.

Subpart K—Waste Disposal

- 20.2001 General requirements.
- 20.2002 Method for obtaining approval of proposed disposal procedures.
- 20.2003 Disposal by release into sanitary sewerage.
- 20.2004 Treatment or disposal by incineration.
- 20.2005 Disposal of specific wastes.
- 20.2006 Transfer for disposal and manifests.
- 20.2007 Compliance with environmental and health protection regulations.

Subpart L—Records

- 20.2101 General provisions.
- 20.2102 Records of radiation protection programs.
- 20.2103 Records of surveys.
- 20.2104 Determination of prior occupational dose.
- 20.2105 Records of planned special exposures.
- 20.2106 Records of individual monitoring results.
- 20.2107 Records of dose to individual members of the public.
- 20.2108 Records of waste disposal.
- 20.2109 Records of testing entry control devices for very high radiation areas.
- 20.2110 Form of records.

Subpart M—Reports

- 20.2201 Reports of theft or loss of licensed material.
- 20.2202 Notification of incidents.
- 20.2203 Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the limits.
- 20.2204 Reports of planned special exposures.
- 20.2205 [Reserved]
- 20.2206 Reports of individual monitoring.

Subpart N—Exemptions and Additional Requirements

- 20.2301 Applications for exemptions.
- 20.2302 Additional requirements.

Subpart O—Enforcement

- 20.2401 Violations.

APPENDIX A TO §§ 20.1001–20.2401—PROTECTION FACTORS FOR RESPIRATORS**APPENDIX B TO §§ 20.1001–20.2401—ANNUAL LIMITS ON INTAKE (ALIs) AND DERIVED AIR CONCENTRATIONS (DACs) OF RADIONUCLIDES FOR OCCUPATIONAL EXPOSURE; EFFLUENT CONCENTRATIONS; CONCENTRATIONS FOR RELEASE TO SEWERAGE****APPENDIX C TO §§ 20.1001–20.2401—QUANTITIES OF LICENSED MATERIAL REQUIRING LABELING****APPENDIX D TO §§ 20.1001–20.2401—UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICES****APPENDIX E TO §§ 20.1001–20.2401—[RESERVED]****APPENDIX F TO §§ 20.1001–20.2401—REQUIREMENTS FOR LOW-LEVEL-WASTE TRANSFER FOR DISPOSAL AT LAND DISPOSAL FACILITIES AND MANIFESTS**

AUTHORITY: Secs. 53, 63, 65, 81, 103, 104, 161, 182, 186, 68 Stat. 930, 933, 935, 936, 937, 948, 953, 955, as amended (42 U.S.C. 2073, 2093, 2095, 2111, 2133, 2134, 2201, 2232, 2236), secs. 201, as amended, 202, 206, 88 Stat. 1242, as amended, 1244, 1246 (U.S.C. 5841, 5842, 5846).

Section 20.408 also issued under secs. 135, 141, Pub. L. 97-425, 96 Stat. 2232, 2241 (42 U.S.C. 10155, 10161).

For the purposes of sec. 233, 68 Stat. 958, as amended (42 U.S.C. 2273): §§ 20.101, 20.102, 20.103 (a), (b), and (f), 20.104 (a) and (b), 20.105(b), 20.106(a), 20.201, 20.202(a), 20.205, 20.207, 20.301, 20.303, 20.304, 20.305, 20.1102, 20.1201–20.1204, 20.1206, 20.1207, 20.1208, 20.1301, 20.1302, 20.1501, 20.1502, 20.1601 (a) and (d), 20.1602, 20.1603, 20.1701, 20.1704, 20.1801, 20.1802, 20.1901(a), 20.1902, 20.1904, 20.1906, 20.2001, 20.2002, 20.2003, 20.2004, 20.2005 (b) and (c), 20.2006, 20.2101–20.2110, 20.2201–20.2206, and 20.2301 are issued under sec. 161b, 68 Stat. 948, as amended (42 U.S.C. 2201(b)); § 20.2106(d) is issued under the Privacy Act of 1974, Pub. L. 93-579, 5 U.S.C. 552a; and §§ 20.102, 20.103(e), 20.401–20.407, 20.408(b), 20.409, 20.1102(a) (2) and (4), 20.1204(e), 20.1206 (g) and (h), 20.1904(e)(4), 20.1905 (c) and (d), 20.2005(e), 20.2006(b)–(d), 20.2101–20.2103, 20.2104(b)–(d), 20.2105–20.2108, and 20.2201–20.2207 are issued under sec. 161o, 68 Stat. 950, as amended (42 U.S.C. 2201(o)).

GENERAL PROVISIONS

§ 20.1 Purpose.

(a) The regulations in this part establish standards for protection against radiation hazards arising out of activities under licenses issued by the Nuclear Regulatory Commission and are issued pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974.

(b) The use of radioactive material or other sources of radiation not licensed by the Commission is not subject to the regulations in this part. However, it is the purpose of the regulations in this part to control the possession, use, and transfer of licensed material by any licensee in such a manner that the total dose to an individual (including exposures to licensed and unlicensed radioactive material and to other unlicensed sources of radiation, whether in the possession of the licensee or any other person, but not including exposures to radiation from natural background sources or medical diagnosis and therapy) does not exceed the standards of radiation protection prescribed in the regulations in this part.

(c) In accordance with recommendations of the Federal Radiation Council, approved by the President, persons engaged in activities under licenses issued by the Nuclear Regulatory Commission pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974 should, in addition to complying with the requirements set forth in this part, make every reasonable effort to maintain radiation exposures, and releases of radioactive materials in effluents to unrestricted areas, as low as is reasonably achievable. The term "as low as is reasonably achievable" means as low as is reasonably achievable taking into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.

[25 FR 10914, Nov. 17, 1960, as amended at 40 FR 8783, Mar. 3, 1975; 40 FR 58847, Dec. 19, 1975; 44 FR 32352, June 6, 1979]

§ 20.2 Scope.

The regulations in this part apply to all persons who receive, possess, use, or transfer material licensed pursuant to the regulations in Parts 30 through 35, 39, 40, 60, 61, 70, or 72 of this chapter, including persons licensed to operate a production or utilization facility pursuant to Part 50 of this chapter.

[53 FR 31680, Aug. 19, 1988]

§ 20.3 Definitions.

(a) As used in this part:

(1) *Act* means the Atomic Energy Act of 1954 (68 Stat. 919) including any amendments thereto;

(2) *Airborne radioactive material* means any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors, or gases;

(3) *Byproduct material* means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material;

(4) *Calendar quarter* means not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be such that no day is included in more than one calendar quarter or omitted from inclusion within a calendar quarter. No licensee shall change the method observed by him of determining calendar quarters except at the beginning of a calendar year.

(5) *Commission* means the Nuclear Regulatory Commission or its duly authorized representatives;

(6) *Government agency* means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government;

by the licensee, the end of a work assignment in the licensee's restricted areas in a given calendar quarter, without expectation or specific scheduling of reentry into the licensee's restricted areas during the remainder of that calendar quarter.

(20) *Dosimetry processor* means an individual or an organization that processes and evaluates personnel monitoring equipment in order to determine the radiation dose delivered to the equipment.

(b) Definitions of certain other words and phrases as used in this part are set forth in other sections, including:

(1) *Airborne radioactivity area* defined in § 20.203;

(2) *Radiation area and high radiation area* defined in § 20.202;

(3) *Personnel monitoring equipment* defined in § 20.202;

(4) *Survey* defined in § 20.201;

(5) Units of measurement of dose (rad, rem) defined in § 20.4;

(6) Units of measurement of radioactivity defined in § 20.5.

(25 FR 10914, Nov. 17, 1960, as amended at 25 FR 13953, Dec. 30, 1960; 27 FR 5905, June 22, 1962; 38 FR 22467, Aug. 21, 1973; 40 FR 8783, Mar. 3, 1975; 40 FR 42558, Sept. 15, 1975; 44 FR 32352, June 6, 1979; 45 FR 14200, Mar. 5, 1980; 46 FR 58282, Dec. 1, 1981; 47 FR 57479, Dec. 27, 1982; 52 FR 4604, Feb. 13, 1987; 52 FR 8240, Mar. 17, 1987)

§ 20.4 Units of radiation dose.

(a) "Dose," as used in this part, is the quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body. When the regulations in this part specify a dose during a period of time, the dose means the total quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body during such period of time. Several different units of dose are in current use. Definitions of units as used in this part are set forth in paragraphs (b) and (c) of this section.

(b) The rad, as used in this part, is a measure of the dose of any ionizing radiation to body tissues in terms of the energy absorbed per unit mass of the tissue. One rad is the dose corresponding to the absorption of 100 ergs per

gram of tissue. (One millirad (mrad)=0.001 rad.)

(c) The rem, as used in this part, is a measure of the dose of any ionizing radiation to body tissues in terms of its estimated biological effect relative to a dose of one roentgen (r) of X-rays. (One millirem (mrem)=0.001 rem.) The relation of the rem to other dose units depends upon the biological effect under consideration and upon the conditions of irradiation. For the purpose of the regulations in this part, any of the following is considered to be equivalent to a dose of one rem:

(1) A dose of 1 r due to X- or gamma radiation;

(2) A dose of 1 rad due to X-, gamma, or beta radiation;

(3) A dose of 0.1 rad due to neutrons or high energy protons;

(4) A dose of 0.05 rad due to particles heavier than protons and with sufficient energy to reach the lens of the eye; If it is more convenient to measure the neutron flux, or equivalent, than to determine the neutron dose in rads, as provided in paragraph (c)(3) of this section, one rem of neutron radiation may, for purposes of the regulations in this part, be assumed to be equivalent to 14 million neutrons per square centimeter incident upon the body; or, if there exists sufficient information to estimate with reasonable accuracy the approximate distribution in energy of the neutrons, the incident number of neutrons per square centimeter equivalent to one rem may be estimated from the following table:

NEUTRON FLUX DOSE EQUIVALENTS

Neutron energy (Mev)	Number of neutrons per square centimeter equivalent to a dose of 1 rem (neutrons/cm ²)	Average flux to deliver 100 millirem in 40 hours (neutrons/cm ² sec.)
Thermal	970 · 10 ⁶	670
0.0001	720 · 10 ⁶	500
0.005	820 · 10 ⁶	570
0.02	400 · 10 ⁶	280
0.1	120 · 10 ⁶	80
0.5	43 · 10 ⁶	30
1.0	26 · 10 ⁶	18
2.5	29 · 10 ⁶	20
5.0	26 · 10 ⁶	18
7.5	24 · 10 ⁶	17
10	24 · 10 ⁶	17

(7) *Individual* means any human being;

(8) *Licensed material* means source material, special nuclear material, or by-product material received, possessed, used, or transferred under a general or specific license issued by the Commission pursuant to the regulations in this chapter;

(9) *License* means a license issued under the regulations in Parts 30 through 35, 39, 40, 60, 61, 70, or Part 72 of this chapter. "Licensee" means the holder of such license;

(10) *Occupational dose* includes exposure of an individual to radiation (i) in a restricted area; or (ii) in the course of employment in which the individual's duties involve exposure to radiation, provided, that "occupational dose" shall not be deemed to include any exposure of an individual to radiation for the purpose of medical diagnosis or medical therapy of such individual.

(11) *Person* means: (i) Any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission or the Department (except that the Department shall be considered a person within the meaning of the regulations in this part to the extent that its facilities and activities are subject to the licensing and related regulatory authority of the Commission pursuant to section 202 of the Energy Reorganization Act of 1974 (88 Stat. 1244)), any State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (ii) any legal successor, representative, agent, or agency of the foregoing.

(12) *Radiation* means any or all of the following: alpha rays, beta rays, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other atomic particles; but not sound or radio waves, or visible, infrared, or ultraviolet light;

(13) *Radioactive material* includes any such material whether or not subject to licensing control by the Commission;

(14) *Restricted area* means any area access to which is controlled by the licensee for purposes of protection of

individuals from exposure to radiation and radioactive materials. "Restricted area" shall not include any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area;

(15) *Source material* means: (i) Uranium or thorium, or any combination thereof, in any physical or chemical form; or (ii) ores which contain by weight one-twentieth of one percent (0.05%) or more of (a) uranium, (b) thorium or (c) any combination thereof. Source material does not include special nuclear material.

(16) *Special nuclear material* means: (i) Plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51 of the act, determines to be special nuclear material, but does not include source material; or (ii) any material artificially enriched by any of the foregoing but does not include source material;

(17) *Unrestricted area* means any area access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters.

(18) *Department* means the Department of Energy established by the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565, 42 U.S.C. 7101 *et seq.*) to the extent that the Department, or its duly authorized representatives, exercises functions formerly vested in the U.S. Atomic Energy Commission, its Chairman, members, officers and components and transferred to the U.S. Energy Research and Development Administration and to the Administrator thereof pursuant to sections 104 (b), (c) and (d) of the Energy Reorganization Act of 1974 (Pub. L. 93-438, 88 Stat. 1233 at 1237, 42 U.S.C. 5814) and retransferred to the Secretary of Energy pursuant to section 301(a) of the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565 at 577-578, 42 U.S.C. 7151).

(19) *Termination* means the end of employment with the licensee or, in the case of individuals not employed

NEUTRON FLUX DOSE EQUIVALENTS—
Continued

Neutron energy (Mev)	Number of neutrons per square centimeter equivalent to a dose of 1 rem (neutrons/cm ²)	Average flux to deliver 100 millirem in 40 hours (neutrons/cm ² sec.)
10 to 30	$14 \cdot 10^{-6}$	10

(d) For determining exposures to X or gamma rays up to 3 Mev, the dose limits specified in §§ 20.101 to 20.104, inclusive, may be assumed to be equivalent to the "air dose". For the purpose of this part "air dose" means that the dose is measured by a properly calibrated appropriate instrument in air at or near the body surface in the region of highest dosage rate.

§ 20.5 Units of radioactivity.

(a) Radioactivity is commonly, and for purposes of the regulations in this part shall be, measured in terms of disintegrations per unit time or in curies. One curie = 3.7×10^{10} disintegrations per second (dps) = 2.2×10^{12} disintegrations per minute (dpm). Commonly used submultiples of the curie are the millicurie and the microcurie:

(1) One millicurie (mCi) = 0.001 curie (Ci) = 3.7×10^7 dps.

(2) One microcurie (μ Ci) = 0.000001 curie = 3.7×10^4 dps.

(25 FR 10914, Nov. 17, 1960, as amended at 38 FR 29314, Oct. 24, 1973; 39 FR 23990, June 28, 1974; 40 FR 50705, Oct. 31, 1975)

§ 20.6 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

§ 20.7 Communications.

Except where otherwise specified in this part, all communications and reports concerning the regulations in this part should be addressed to the Executive Director for Operations, U.S. Nuclear Regulatory Commission,

Washington, DC 20555. Communications, reports, and applications may be delivered in person at the Commission's offices at 2120 L Street, NW., Washington, DC, or at 11555 Rockville Pike, Rockville, Maryland.

[53 FR 6139, Mar. 1, 1988, as amended at 53 FR 43420, Oct. 27, 1988]

§ 20.8 Information collection requirements: OMB approval.

(a) The Nuclear Regulatory Commission has submitted the information collection requirements contained in this part to the Office of Management and Budget (OMB) for approval as required by the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.). OMB has approved the information collection requirements contained in this part under control number 3150-0014.

(b) The approved information collection requirements contained in this part appear in §§ 20.102, 20.103, 20.105, 20.106, 20.203, 20.205, 20.302, 20.311, 20.401, 20.402, 20.403, 20.405, 20.407, 20.408, and 20.409.

(c) This part contains information collection requirements in addition to those approved under the control number specified in paragraph (a) of this section. These information collection requirements and the control numbers under which they are approved are as follows:

(1) In §§ 20.101 and 20.102, Form NRC-4 is approved under control number 3150-0005.

(2) In § 20.401, Form NRC-5 is approved under control number 3150-0006.

[49 FR 19624, May 9, 1984]

PERMISSIBLE DOSES, LEVELS, AND
CONCENTRATIONS

§ 20.101 Radiation dose standards for individuals in restricted areas.

(a) In accordance with the provisions of § 20.102(a), and except as provided in paragraph (b) of this section, no licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from radioactive material and other sources of radiation a

total occupational dose in excess of the standards specified in the following table:

REMS PER CALENDAR QUARTER

1 Whole body, head and trunk; active blood-forming organs; lens of eyes; or gonads.....	14.
2 Hands and forearms; feet and ankles.....	18 ² .
3 Skin of whole body.....	7 ¹ / ₂ .

(b) A licensee may permit an individual in a restricted area to receive a total occupational dose to the whole body greater than that permitted under paragraph (a) of this section, provided:

(1) During any calendar quarter the total occupational dose to the whole body shall not exceed 3 rems; and

(2) The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed 5 (N-18) rems where "N" equals the individual's age in years at his last birthday; and

(3) The licensee has determined the individual's accumulated occupational dose to the whole body on Form NRC-4, or on a clear and legible record containing all the information required in that form; and has otherwise complied with the requirements of § 20.102. As used in paragraph (b), "Dose to the whole body" shall be deemed to include any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of eye.

[25 FR 10914, Nov. 17, 1960, as amended at 44 FR 32352, June 6, 1979]

§ 20.102 Determination of prior dose.

(a) Each licensee shall require any individual, prior to first entry of the individual into the licensee's restricted area during each employment or work assignment under such circumstances that the individual will receive or is likely to receive in any period of one calendar quarter an occupational dose in excess of 25 percent of the applicable standards specified in § 20.101(a) and § 20.104(a), to disclose in a written, signed statement, either: (1) That the individual had no prior occupational dose during the current calendar quarter, or (2) the nature and amount of any occupational dose which the individual may have re-

ceived during that specifically identified current calendar quarter from sources of radiation possessed or controlled by other persons. Each licensee shall maintain records of such statements until the Commission authorizes their disposition.

(b) Before permitting, pursuant to § 20.101(b), any individual in a restricted area to receive an occupational radiation dose in excess of the standards specified in § 20.101(a), each licensee shall:

(1) Obtain a certificate on Form NRC-4, or on a clear and legible record containing all the information required in that form, signed by the individual showing each period of time after the individual attained the age of 18 in which the individual received an occupational dose of radiation; and

(2) Calculate on Form NRC-4 in accordance with the instructions appearing therein, or on a clear and legible record containing all the information required in that form, the previously accumulated occupational dose received by the individual and the additional dose allowed for that individual under § 20.101(b).

(c)(1) In the preparation of Form NRC-4, or a clear and legible record containing all the information required in that form, the licensee shall make a reasonable effort to obtain reports of the individual's previously accumulated occupational dose. For each period for which the licensee obtains such reports, the licensee shall use the dose shown in the report in preparing the form. In any case where a licensee is unable to obtain reports of the individual's occupational dose for a previous complete calendar quarter, it shall be assumed that the individual has received the occupational dose specified in whichever of the following columns apply:

Part of body	Column 1— Assumed exposure in rems for calendar quarters prior to Jan. 1, 1961	Column 2— Assumed exposure in rems for calendar quarters beginning on or after Jan. 1, 1961
Whole body, gonads, active blood-forming organs, head and trunk, lens of eye	3%	1%

(2) The licensee shall retain and preserve records used in preparing Form NRC-4 until the Commission authorizes their disposition.

If calculation of the individual's accumulated occupational dose for all periods prior to January 1, 1961 yields a result higher than the applicable accumulated dose value for the individual as of that date, as specified in paragraph (b) of § 20.101, the excess may be disregarded.

(25 FR 10914, Nov. 17, 1960, as amended at 41 FR 18301, May 3, 1976; 44 FR 32352, June 6, 1979)

§ 20.103 Exposure of individuals to concentrations of radioactive materials in air in restricted areas.

(a)(1) No licensee shall possess, use, or transfer licensed material in such a manner as to permit any individual in a restricted area to inhale a quantity of radioactive material in any period of one calendar quarter greater than the quantity which would result from inhalation for 40 hours per week for 13 weeks at uniform concentrations of radioactive material in air specified in Appendix B, Table I, Column 1.^{1, 2, 3} If

¹Since the concentration specified for tritium oxide vapor assumes equal intakes by skin absorption and inhalation, the total intake permitted is twice that which would result from inhalation alone at the concentration specified for H³S in Appendix B, Table I, Column 1 for 40 hours per week for 13 weeks.

²For radon-222, the limiting quantity is that inhaled in a period of one calendar year. For radioactive materials designated "Sub" in the "Isotope" column of the table, the concentration value specified is based upon exposure to the material as an external radiation source. Individual exposures to these materials may be accounted for as part of the limitation on individual dose in

the radioactive material is of such form that intake by absorption through the skin is likely. Individual exposures to radioactive material shall be controlled so that the uptake of radioactive material by any organ from either inhalation or absorption or both routes of intake⁴ in any calendar quarter does not exceed that which would result from inhaling such radioactive material for 40 hours per week for 13 weeks at uniform concentrations specified in Appendix B, Table I, Column 1.

(2) No licensee shall possess, use, or transfer mixtures of U-234, U-235, and U-238 in soluble form in such a manner as to permit any individual in a restricted area to inhale a quantity of such material in excess of the intake limits specified in Appendix B, Table I, Column 1 of this part. If such soluble uranium is of a form such that absorption through the skin is likely, individual exposures to such material shall be controlled so that the uptake of such material by any organ from either inhalation or absorption or both routes of intake⁴ does not exceed that which would result from inhaling

§ 20.101. These nuclides shall be subject to the precautionary procedures required by § 20.103(b)(1).

³Multiply the concentration values specified in Appendix B, Table I, Column 1, by 6.3×10^4 ml to obtain the quarterly quantity limit. Multiply the concentration value specified in Appendix B, Table I, Column 1, by 2.5×10^4 ml to obtain the annual quantity limit for Rn-222.

⁴Significant intake by ingestion or injection is presumed to occur only as a result of circumstances such as accident, inadvertence, poor procedure, or similar special conditions. Such intakes must be evaluated and accounted for by techniques and procedures as may be appropriate to the circumstances of the occurrence. Exposures so evaluated shall be included in determining whether the limitation on individual exposures in § 20.103(a)(1) has been exceeded.

⁵Regulatory guidance on assessment of individual intakes of radioactive material is given in Regulatory Guide 8.9, "Acceptable Concepts, Models, Equations and Assumptions for a Bioassay Program," single copies of which are available from the Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, upon written request.

such material at the limits specified in Appendix B, Table I, Column 1 and footnote 4 thereto.

(3) For purposes of determining compliance with the requirements of this section the licensee shall use suitable measurements of concentrations of radioactive materials in air for detecting and evaluating airborne radioactivity in restricted areas and in addition, as appropriate, shall use measurements of radioactivity in the body, measurements of radioactivity excreted from the body, or any combination of such measurements as may be necessary for timely detection and assessment of individual intakes of radioactivity by exposed individuals. It is assumed that an individual inhales radioactive material at the airborne concentration in which he is present unless he uses respiratory protective equipment pursuant to paragraph (c) of this section. When assessment of a particular individual's intake of radioactive material is necessary, intakes less than those which would result from inhalation for 2 hours in any one day or for 10 hours in any one week at uniform concentrations specified in Appendix B, Table I, Column 1 need not be included in such assessment, provided that for any assessment in excess of these amounts the entire amount is included.

(b)(1) The licensee shall, as a precautionary procedure, use process or other engineering controls, to the extent practicable, to limit concentrations of radioactive materials in air to levels below those which delimit an airborne radioactivity area as defined in § 20.203(d)(1)(ii).

(2) When it is impracticable to apply process or other engineering controls to limit concentrations of radioactive material in air below those defined in § 20.203(d)(1)(ii), other precautionary procedures, such as increased surveillance, limitation of working times, or provision of respiratory protective equipment, shall be used to maintain intake of radioactive material by any individual within any period of seven consecutive days as far below that intake of radioactive material which would result from inhalation of such material for 40 hours at the uniform concentrations specified in Appendix

B, Table I, Column 1 as is reasonably achievable. Whenever the intake of radioactive material by any individual exceeds this 40-hour control measure, the licensee shall make such evaluations and take such actions as are necessary to assure against recurrence. The licensee shall maintain records of such occurrences, evaluations, and actions taken in a clear and readily identifiable form suitable for summary review and evaluation.

(c) When respiratory protective equipment is used to limit the inhalation of airborne radioactive material pursuant to paragraph (b)(2) of this section, the licensee shall use equipment that is certified or had certification extended by the National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA). The licensee may make allowance for this use of respiratory protective equipment in estimating exposures of individuals to this material provided that:

(1) The licensee selects respiratory protective equipment that provides a protection factor greater than the multiple by which peak concentrations of airborne radioactive materials in the working area are expected to exceed the values specified in Appendix B, Table I, Column 1 of this part. The equipment so selected shall be used so that the average concentration of radioactive material in the air that is inhaled during any period of uninterrupted use in an airborne radioactivity area, on any day, by any individual using the equipment, does not exceed the values specified in Appendix B, Table I, Column 1 of this part. For the purposes of this paragraph, the concentration of radioactive material in the air that is inhaled when respirators are worn may be estimated by dividing the ambient concentration in air by the protection factor specified in Appendix A of this part. If the exposure is later found to be greater than estimated, the corrected value shall be used; if the exposure is later found to be less than estimated, the corrected value may be used.

(2) The licensee maintains and implements a respiratory protection program that includes, as a minimum: air sampling sufficient to identify the

hazard, permit proper equipment selection and estimate exposures; surveys and bioassays as appropriate to evaluate actual exposures; written procedures regarding selection, fitting, and maintenance of respirators, and testing of respirators for operability immediately prior to each use; written procedures regarding supervision and training of personnel and issuance records; and determination by a physician prior to initial use of respirators, and at least every 12 months thereafter, that the individual user is physically able to use the respiratory protective equipment.

(3) A written policy statement on respirator usage shall be issued covering such things as: use of practicable engineering controls instead of respirators; routine, nonroutine, and emergency use of respirators; and periods of respirator use and relief from respirator use. The licensee shall advise each respirator user that the user may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other condition that might require such relief.

(4) The licensee uses equipment within limitations for type and mode of use and provides proper visual, communication, and other special capabilities (such as adequate skin protection) when needed.

(d) Unless otherwise authorized by the Commission, the licensee shall not assign protection factors in excess of those specified in Appendix A of this part in selecting and using respiratory protective equipment. The Commission may authorize a licensee to use higher protection factors on receipt of an application (1) describing the situation for which a need exists for higher protection factors, and (2) demonstrating that the respiratory protective equipment will provide these higher protection factors under the proposed conditions of use.

(e) Where equipment of a particular type has not been tested and certified, or had certification extended, by NIOSH/MSHA, or where there is no existing schedule for test and certifica-

tion of certain equipment, the licensee shall not make allowance for this equipment without specific authorization by the Commission. An application for this authorization must include a demonstration by testing, or on the basis of reliable test information, that the material and performance characteristics of the equipment are capable of providing the proposed degree of protection under anticipated conditions of use.

(f) Only equipment that has been specifically certified or had certification extended for emergency use by NIOSH/MSHA shall be used as emergency devices.

(g) The licensee shall notify, in writing, the Regional Administrator of the appropriate Nuclear Regulatory Commission Regional Office listed in Appendix D at least 30 days before the date that respiratory protective equipment is first used under the provisions of this section.

[41 FR 52301, Nov. 29, 1976, as amended at 43 FR 29270, July 7, 1978; 47 FR 16164, Apr. 15, 1982; 52 FR 31610, Aug. 21, 1987; 53 FR 17689, May 18, 1988]

§ 20.104 Exposure of minors.

(a) No licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual within a restricted area who is under 18 years of age, to receive in any period of one calendar quarter from radioactive material and other sources of radiation in the licensee's possession a dose in excess of 10 percent of the limits specified in the table in paragraph (a) of § 20.101.

(b) No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual within a restricted area, who is under 18 years of age to be exposed to airborne radioactive material possessed by the licensee in an average concentration in excess of the limits specified in Appendix B, Table II of this part. For purposes of this paragraph, concentrations may be averaged over periods not greater than a week.

(c) The provisions of §§ 20.103(b)(2) and 20.103(c) shall apply to exposures subject to paragraph (b) of this section except that the references in

§§ 20.103(b)(2) and 20.103(c) to Appendix B, Table I, Column 1 shall be deemed to be references to Appendix B, Table II, Column 1.

[25 FR 10914, Nov. 17, 1960, as amended at 41 FR 52302, Nov. 29, 1976]

§ 20.105 Permissible levels of radiation in unrestricted areas.

(a) There may be included in any application for a license or for amendment of a license proposed limits upon levels of radiation in unrestricted areas resulting from the applicant's possession or use of radioactive material and other sources of radiation. Such applications should include information as to anticipated average radiation levels and anticipated occupancy times for each unrestricted area involved. The Commission will approve the proposed limits if the applicant demonstrates that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of one calendar year in excess of 0.5 rem.

(b) Except as authorized by the Commission pursuant to paragraph (a) of this section, no licensee shall possess, use or transfer licensed material in such a manner as to create in any unrestricted area from radioactive material and other sources of radiation in his possession:

(1) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of two millirems in any one hour, or

(2) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any seven consecutive days.

(c) In addition to other requirements of this part, licensees engaged in uranium fuel cycle operations subject to the provisions of 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations," shall comply with that part.

[25 FR 10914, Nov. 17, 1960, and 46 FR 18526, Mar. 25, 1981]

§ 20.106 Radioactivity in effluents to unrestricted areas.

(a) A licensee shall not possess, use, or transfer licensed material so as to release to an unrestricted area radioactive material in concentrations which exceed the limits specified in Appendix B, Table II of this part, except as authorized pursuant to § 20.302 or paragraph (b) of this section. For purposes of this section concentrations may be averaged over a period not greater than one year.

(b) An application for a license or amendment may include proposed limits higher than those specified in paragraph (a) of this section. The Commission will approve the proposed limits if the applicant demonstrates:

(1) That the applicant has made a reasonable effort to minimize the radioactivity contained in effluents to unrestricted areas; and

(2) That it is not likely that radioactive material discharged in the effluent would result in the exposure of an individual to concentrations of radioactive material in air or water exceeding the limits specified in Appendix B, Table II of this part.

(c) An application for higher limits pursuant to paragraph (b) of this section shall include information demonstrating that the applicant has made a reasonable effort to minimize the radioactivity discharged in effluents to unrestricted areas, and shall include, as pertinent:

(1) Information as to flow rates, total volume of effluent, peak concentration of each radionuclide in the effluent, and concentration of each radionuclide in the effluent averaged over a period of one year at the point where the effluent leaves a stack, tube, pipe, or similar conduit;

(2) A description of the properties of the effluents, including:

(i) Chemical composition;

(ii) Physical characteristics, including suspended solids content in liquid effluents, and nature of gas or aerosol for air effluents;

(iii) The hydrogen ion concentrations (pH) of liquid effluents; and

(iv) The size range of particulates in effluents released into air.

(3) A description of the anticipated human occupancy in the unrestricted area where the highest concentration of radioactive material from the effluent is expected, and, in the case of a river or stream, a description of water uses downstream from the point of release of the effluent.

(4) Information as to the highest concentration of each radionuclide in an unrestricted area, including anticipated concentrations averaged over a period of one year:

(i) In air at any point of human occupancy; or

(ii) In water at points of use downstream from the point of release of the effluent.

(5) The background concentration of radionuclides in the receiving river or stream prior to the release of liquid effluent.

(6) A description of the environmental monitoring equipment, including sensitivity of the system, and procedures and calculations to determine concentrations of radionuclides in the unrestricted area and possible reconcentrations of radionuclides.

(7) A description of the waste treatment facilities and procedures used to reduce the concentration of radionuclides in effluents prior to their release.

(d) For the purposes of this section the concentration limits in Appendix B, Table II of this part shall apply at the boundary of the restricted area. The concentration of radioactive material discharged through a stack, pipe or similar conduit may be determined with respect to the point where the material leaves the conduit. If the conduit discharges within the restricted area, the concentration at the boundary may be determined by applying appropriate factors for dilution, dispersion, or decay between the point of discharge and the boundary.

(e) In addition to limiting concentrations in effluent streams, the Commission may limit quantities of radioactive materials released in air or water during a specified period of time if it appears that the daily intake of radioactive material from air, water, or food by a suitable sample of an exposed population group, averaged over a period not exceeding one year, would

otherwise exceed the daily intake resulting from continuous exposure to air or water containing one-third the concentration of radioactive materials specified in Appendix B, Table II of this part.

(f) The provisions of paragraphs (a) through (e) of this section do not apply to disposal of radioactive material into sanitary sewerage systems, which is governed by § 20.303.

(g) In addition to other requirements of this part, licensees engaged in uranium fuel cycle operations subject to the provisions of 40 CFR Part 190, "Environmental Radiation Protection Standard for Nuclear Power Operations," shall comply with that part.

(Secs. 161b., 161o., Pub. L. 83-703, 68 Stat. 948, 950 (42 U.S.C. 2201); sec. 201, as amended, Pub. L. 93-438, 88 Stat. 1243, Pub. L. 94-79, 89 Stat. 413, (42 U.S.C. 5841); Memorandum of Understanding between the Environmental Protection Agency and the Atomic Energy Commission, August 1973, 38 FR 24936, September 11, 1973)

[29 FR 14434, Oct. 21, 1964, as amended at 46 FR 18526, Mar. 25, 1981]

§ 20.107 Medical diagnosis and therapy.

Nothing in the regulations in this part shall be interpreted as limiting the intentional exposure of patients to radiation for the purpose of medical diagnosis or medical therapy.

§ 20.108 Orders requiring furnishing of bio-assay services.

Where necessary or desirable in order to aid in determining the extent of an individual's exposure to concentrations of radioactive material, the Commission may incorporate appropriate provisions in any license, directing the licensee to make available to the individual appropriate bio-assay services and to furnish a copy of the reports of such services to the Commission.

PRECAUTIONARY PROCEDURES

§ 20.201 Surveys.

(a) As used in the regulations in this part, "survey" means an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a spe-

cific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment, and measurements of levels of radiation or concentrations of radioactive material present.

(b) Each licensee shall make or cause to be made such surveys as (1) may be necessary for the licensee to comply with the regulations in this part, and (2) are reasonable under the circumstances to evaluate the extent of radiation hazards that may be present.

[25 FR 10914, Nov. 17, 1960, as amended at 46 FR 53648, Oct. 30, 1981]

§ 20.202 Personnel monitoring.

(a) Each licensee shall supply appropriate personnel monitoring equipment to, and shall require the use of such equipment by:

(1) Each individual who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 25 percent of the applicable value specified in paragraph (a) of § 20.101.

(2) Each individual under 18 years of age who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 5 percent of the applicable value specified in paragraph (a) of § 20.101.

(3) Each individual who enters a high radiation area.

(b) As used in this part,

(1) "Personnel monitoring equipment" means devices designed to be worn or carried by an individual for the purpose of measuring the dose received (e.g., film badges, pocket chambers, pocket dosimeters, film rings, etc.);

(2) "Radiation area" means any area, accessible to personnel, in which there exists radiation, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirem, or in any 5 consecutive days a dose in excess of 100 millirems;

(3) "High radiation area" means any area, accessible to personnel, in which there exists radiation originating in whole or in part within licensed mate-

rial at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem.

(c) All personnel dosimeters (except for direct and indirect reading pocket ionization chambers and those dosimeters used to measure the dose to hands and forearms, feet and ankles) that require processing to determine the radiation dose and that are utilized by licensees to comply with paragraph (a) of this section, with other applicable provisions of 10 CFR Chapter I, or with conditions specified in a licensee's license must be processed and evaluated by a dosimetry processor:

(1) Holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Bureau of Standards, and

(2) Approved in this accreditation process for the type of radiation or radiations included in the NVLAP program that most closely approximate the type of radiation or radiations for which the individual wearing the dosimeter is monitored.

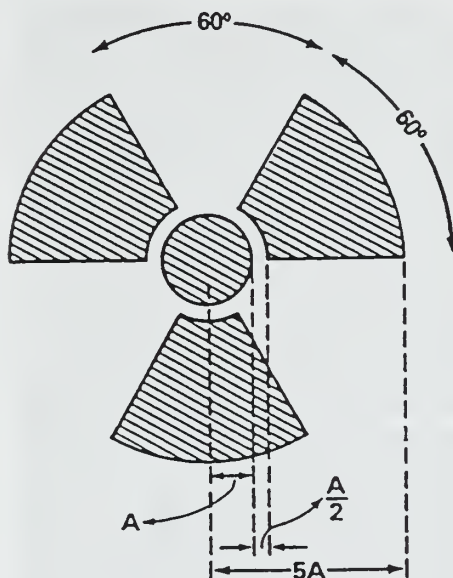
[25 FR 10914, Nov. 17, 1960, as amended at 52 FR 4604, Feb. 13, 1987]

§ 20.203 Caution signs, labels, signals and controls.

(a) *General* (1) Except as otherwise authorized by the Commission, symbols prescribed by this section shall use the conventional radiation caution colors (magenta or purple on yellow background). The symbol prescribed by this section is the conventional three-bladed design:

RADIATION SYMBOL

1. Cross-hatched area is to be magenta or purple.
2. Background is to be yellow.



(2) In addition to the contents of signs and labels prescribed in this section, licensees may provide on or near such signs and labels any additional information which may be appropriate in aiding individuals to minimize exposure to radiation or to radioactive material.

(b) *Radiation areas.* Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION¹

RADIATION AREA

(c) *High radiation areas.* (1) Each high radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION¹

HIGH RADIATION AREA

(2) Each entrance or access point to a high radiation area shall be:

(i) Equipped with a control device which shall cause the level of radiation to be reduced below that at

¹ Or "Danger".

which an individual might receive a dose of 100 millirems in 1 hour upon entry into the area; or

(ii) Equipped with a control device which shall energize a conspicuous visible or audible alarm signal in such a manner that the individual entering the high radiation area and the licensee or a supervisor of the activity are made aware of the entry; or

(iii) Maintained locked except during periods when access to the area is required, with positive control over each individual entry.

(3) The controls required by paragraph (c)(2) of this section shall be established in such a way that no individual will be prevented from leaving a high radiation area.

(4) In the case of a high radiation area established for a period of 30 days or less, direct surveillance to prevent unauthorized entry may be substituted for the controls required by paragraph (c)(2) of this section.

(5) Any licensee, or applicant for a license, may apply to the Commission for approval of methods not included in paragraphs (c)(2) and (4) of this section for controlling access to high radiation areas. The Commission will approve the proposed alternatives if the licensee or applicant demonstrates that the alternative methods of control will prevent unauthorized entry into a high radiation area, and that the requirement of paragraph (c)(3) of this section is met.

(6) Each area in which there may exist radiation levels in excess of 500 rems in one hour at one meter from a sealed radioactive source² that is used to irradiate materials shall:

² This paragraph (c)(6) does not apply to radioactive sources that are used in teletherapy, in radiography, or in completely self-shielded irradiators in which the source is both stored and operated within the same shielding radiation barrier and, in the designed configuration of the irradiator, is always physically inaccessible to any individual and cannot create high levels of radiation in an area that is accessible to any individual. This paragraph (c)(6) also does not apply to sources from which the radiation is incidental to some other use nor to nuclear reactor-generated radiation other than radiation from byproduct, source, or special nu

Continued

(i) Have each entrance or access point equipped with entry control devices which shall function automatically to prevent any individual from inadvertently entering the area when such radiation levels exist; permit deliberate entry into the area only after a control device is actuated that shall cause the radiation level within the area, from the sealed source, to be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour; and prevent operation of the source if the source would produce radiation levels in the area that could result in a dose to an individual in excess of 100 mrem in one hour. The entry control devices required by this paragraph (c)(6) shall be established in such a way that no individual will be prevented from leaving the area.

(ii) Be equipped with additional control devices such that upon failure of the entry control devices to function as required by paragraph (c)(6)(i) of this section the radiation level within the area, from the sealed source, shall be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour; and visible and audible alarm signals shall be generated to make an individual attempting to enter the area aware of the hazard and the licensee or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of such failure of the entry control devices.

clear materials that are used in sealed sources in non-self-shielded irradiators.

* These requirements apply after Mar. 14, 1978. Each person licensed to conduct activities to which this paragraph (c)(6) applies and who is not in compliance with the provisions of this paragraph on Mar. 14, 1978, shall file with the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, on or before June 14, 1978, information describing in detail the actions taken or to be taken to achieve compliance with this paragraph by Dec. 14, 1978, and may continue activities in conformance with present license conditions and the provisions of the previously effective § 20.2034 until such compliance is achieved. For such persons compliance must be achieved not later than Dec. 14, 1978.

(iii) Be equipped with control devices such that upon failure or removal of physical radiation barriers other than the source's shielded storage container the radiation level from the source shall be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour; and visible and audible alarm signals shall be generated to make potentially affected individuals aware of the hazard and the licensee or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of the failure or removal of the physical barrier. When the shield for the stored source is a liquid, means shall be provided to monitor the integrity of the shield and to signal, automatically, loss of adequate shielding. Physical radiation barriers that comprise permanent structural components, such as walls, that have no credible probability of failure or removal in ordinary circumstances need not meet the requirements of this paragraph (c)(6)(iii).

(iv) Be equipped with devices that will automatically generate visible and audible alarm signals to alert personnel in the area before the source can be put into operation and in sufficient time for any individual in the area to operate a clearly identified control device which shall be installed in the area and which can prevent the source from being put into operation.

(v) Be controlled by use of such administrative procedure and such devices as are necessary to assure that the area is cleared of personnel prior to each use of the source preceding which use it might have been possible for an individual to have entered the area.

(vi) Be checked by a physical radiation measurement to assure that prior to the first individual's entry into the area after any use of the source, the radiation level from the source in the area is below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour.

(vii) Have entry control devices required in paragraph (c)(6)(i) of this section which have been tested for proper functioning prior to initial op-

eration with such source of radiation on any day that operations are not uninterruptedly continued from the previous day or before resuming operations after any unintended interruption, and for which records are kept of the dates, times, and results of such tests of function. No operations other than those necessary to place the source in safe condition or to effect repairs on controls shall be conducted with such source unless control devices are functioning properly. The licensee shall submit an acceptable schedule for more complete periodic tests of the entry control and warning systems to be established and adhered to as a condition of the license.

(viii) Have those entry and exit portals that are used in transporting materials to and from the irradiation area, and that are not intended for use by individuals, controlled by such devices and administrative procedures as are necessary to physically protect and warn against inadvertent entry by any individual through such portals. Exit portals for processed materials shall be equipped to detect and signal the presence of loose radiation sources that are carried toward such an exit and to automatically prevent such loose sources from being carried out of the area.

(7) Licensees with, or applicants for, licenses for radiation sources that are within the purview of paragraph (c)(6) of this section, and that must be used in a variety of positions or in peculiar locations, such as open fields or forests, that make it impracticable to comply with certain requirements of paragraph (c)(6) of this section, such as those for the automatic control of radiation levels, may apply to the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, for approval, prior to use of safety measures that are alternative to those specified in paragraph (c)(6) of this section, and that will provide at least an equivalent degree of personnel protection in the use of such sources. At least one of the alternative measures must include an entry-preventing interlock control based on a physical measurement of radiation that assures the absence of high radi-

ation levels before an individual can gain access to an area where such sources are used.

(d) *Airborne radioactivity areas.* (1) As used in the regulations in this part "airborne radioactivity area" means (i) any room, enclosure, or operating area in which airborne radioactive materials composed wholly or partly of licensed material, exist in concentrations in excess of the amounts specified in Appendix B, Table I, Column 1 of this part; or (ii) any room, enclosure, or operating area in which airborne radioactive material composed wholly or partly of licensed material exists in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in Appendix B Table I, Column 1 of this part.

(2) Each airborne radioactivity area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION ¹

AIRBORNE RADIOACTIVITY AREA

(e) *Additional requirements.* (1) Each area or room in which licensed material is used or stored and which contains any radioactive material (other than natural uranium or thorium) in an amount exceeding 10 times the quantity of such material specified in Appendix C of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION ¹

RADIOACTIVE MATERIAL(S)

(2) Each area or room in which natural uranium or thorium is used or stored in any amount exceeding one hundred times the quantity specified in Appendix C of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

¹ See footnote 1 to paragraph (b).

¹ See footnote 1 to paragraph (b).

CAUTION¹

RADIOACTIVE MATERIAL(S)

(f) *Containers.* (1) Except as provided in paragraph (f)(3) of this section, each container of licensed material shall bear a durable, clearly visible label identifying the radioactive contents.

(2) A label required pursuant to paragraph (f)(1) of this section shall bear the radiation caution symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL". It shall also provide sufficient information² to permit individuals handling or using the containers, or working in the vicinity thereof, to take precautions to avoid or minimize exposures.

(3) Notwithstanding the provisions of paragraph (f)(1) of this section labeling is not required:

(i) For containers that do not contain licensed materials in quantities greater than the applicable quantities listed in Appendix C of this part.

(ii) For containers containing only natural uranium or thorium in quantities no greater than 10 times the applicable quantities listed in Appendix C of this part.

(iii) For containers that do not contain licensed materials in concentrations greater than the applicable concentrations listed in Appendix B, Table I, Column 2, of this part.

(iv) For containers when they are attended by an individual who takes the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established by the regulations in this part.

(v) For containers when they are in transport and packaged and labeled in accordance with regulations of the Department of Transportation.

(vi) For containers which are accessible³ only to individuals authorized to

handle or use them, or to work in the vicinity thereof, provided that the contents are identified to such individuals by a readily available written record.

(vii) For manufacturing or process equipment, such as nuclear reactors, reactor components, piping, and tanks.

(4) Each licensee shall, prior to disposal of an empty uncontaminated container to unrestricted areas, remove or deface the radioactive material label or otherwise clearly indicate that the container no longer contains radioactive materials.

[25 FR 10914, Nov. 17, 1960, as amended at 31 FR 10515, Aug. 5, 1966; 34 FR 19546, Dec. 11, 1969; 35 FR 5033, Mar. 25, 1970; 42 FR 64620, Dec. 27, 1977; 43 FR 2167, Jan. 16, 1978; 43 FR 22172, May 24, 1978]

§ 20.204 Same: Exceptions.

Notwithstanding the provisions of § 20.203,

(a) A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level twelve inches from the surface of the source container or housing does not exceed five millirem per hour.

(b) Rooms or other areas in hospitals are not required to be posted with caution signs, and control of entrance or access thereto pursuant to § 20.203(c) is not required, because of the presence of patients containing by-product material provided that there are personnel in attendance who will take the precautions necessary to prevent the exposure of any individual to radiation or radioactive material in excess of the limits established in the regulations in this part.

(c) Caution signs are not required to be posted at areas or rooms containing radioactive materials for periods of less than eight hours provided that (1) the materials are constantly attended during such periods by an individual who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established in the regulations in this part and; (2) such area or room is subject to the licensee's control.

(d) A room or other area is not required to be posted with a caution

¹ See footnote 1 to paragraph (b).

² As appropriate, the information will include radiation levels, kinds of material, estimate of activity, date for which activity is estimated, mass enrichment, etc.

³ For example, containers in locations such as water-filled canals, storage vaults, or hot cells.

sign, and control is not required for each entrance or access point to a room or other area which is a high radiation area solely because of the presence of radioactive materials prepared for transport and packaged and labeled in accordance with regulations of the Department of Transportation.

(25 FR 10914, Nov. 17, 1960, as amended at 35 FR 5033, Mar. 25, 1970)

§ 20.205 Procedures for picking up, receiving, and opening packages.

(a)(1) Each licensee who expects to receive a package containing quantities of radioactive material in excess of the Type A quantities specified in paragraph (b) of this section shall:

(i) If the package is to be delivered to the licensee's facility by the carrier, make arrangements to receive the package when it is offered for delivery by the carrier; or

(ii) If the package is to be picked up by the licensee at the carrier's terminal, make arrangements to receive notification from the carrier of the arrival of the package, at the time of arrival.

(2) Each licensee who picks up a package of radioactive material from a carrier's terminal shall pick up the package expeditiously upon receipt of notification from the carrier of its arrival.

(b)(1) Each licensee, upon receipt of a package of radioactive material, shall monitor the external surfaces of the package for radioactive contamination caused by leakage of the radioactive contents, except:

(i) Packages containing no more than the exempt quantity specified in the table in this paragraph;

(ii) Packages containing no more than 10 millicuries of radioactive material consisting solely of tritium, carbon-14, sulfur-35, or iodine-125;

(iii) Packages containing only radioactive material as gases or in special form;

(iv) Packages containing only radioactive material in other than liquid form (including Mo-99/Tc-99m generators) and not exceeding the Type A quantity limit specified in the table in this paragraph; and

(v) Packages containing only radionuclides with half-lives of less than 30

days and a total quantity of no more than 100 millicuries.

The monitoring shall be performed as soon as practicable after receipt, but no later than three hours after the package is received at the licensee's facility if received during the licensee's normal working hours, or eighteen hours if received after normal working hours.

(2) If removable radioactive contamination in excess of 0.01 microcuries (22,000 disintegrations per minute) per 100 square centimeters of package surface is found on the external surfaces of the package, the licensee shall immediately notify the final delivering carrier and, by telephone and telegraph, mailgram or facsimile, the appropriate Nuclear Regulatory Commission Regional Office shown in Appendix D of this part.

TABLE OF EXEMPT AND TYPE A QUANTITIES

Transport group	Exempt quantity limit (in millicuries)	Type A quantity limit (in curies)
I _____	.01	0.001
II _____	0.1	0.050
III _____	1	3
IV _____	1	20
V _____	1	20
VI _____	1	1000
VII _____	25,000	1000
Special Form _____	1	20

(c)(1) Each licensee, upon receipt of a package containing quantities of radioactive material in excess of the Type A quantities specified in paragraph (b) of this section, other than those transported by exclusive use vehicle, shall monitor the radiation levels external to the package. The package shall be monitored as soon as practicable after receipt, but no later than three hours after the package is received at the licensee's facility if received during the licensee's normal working hours, or 18 hours if received after normal working hours.

(2) If radiation levels are found on the external surface of the package in excess of 200 millirem per hour, or at three feet from the external surface of the package in excess of 10 millirem per hour, the licensee shall immediately notify by telephone and telegraph

mailgram, or facsimile, the director of the appropriate NRC Regional Office listed in Appendix D, and the final delivering carrier.

(d) Each licensee shall establish and maintain procedures for safely opening packages in which licensed material is received, and shall assure that such procedures are followed and that due consideration is given to special instructions for the type of package being opened.

[39 FR 17974, May 22, 1974, as amended at 41 FR 16445, Apr. 19, 1976; 49 FR 19624, May 9, 1984]

§ 20.206 Instruction of personnel.

Instructions required for individuals working in or frequenting any portion of a restricted area are specified in § 19.12 of this chapter.

[38 FR 22220, Aug. 17, 1973]

§ 20.207 Storage and control of licensed materials in unrestricted areas.

(a) Licensed materials stored in an unrestricted area shall be secured from unauthorized removal from the place of storage.

(b) Licensed materials in an unrestricted area and not in storage shall be tended under the constant surveillance and immediate control of the licensee.

[40 FR 26679, June 25, 1975]

WASTE DISPOSAL

§ 20.301 General requirement.

No licensee shall dispose of licensed material except:

(a) By transfer to an authorized recipient as provided in the regulations in Parts 30, 40, 60, 61, 70 or 72 of this chapter, whichever may be applicable; or

(b) As authorized pursuant to § 20.302 or Part 61 of this chapter; or

(c) As provided in § 20.303, applicable to the disposal of licensed material by release into sanitary sewerage systems, or in § 20.306 for disposal of specific wastes, or in § 20.106 (Radioactivity in effluents to unrestricted areas).

[25 FR 10914, Nov. 17, 1960, as amended at 46 FR 16234, Mar. 11, 1981; 46 FR 58282, Dec. 1, 1981; 47 FR 57479, Dec. 27, 1982]

§ 20.302 Method for obtaining approval of proposed disposal procedures.

(a) Any licensee or applicant for a license may apply to the Commission for approval of proposed procedures to dispose of licensed material in a manner not otherwise authorized in the regulations in this chapter. Each application should include a description of the licensed material and any other radioactive material involved, including the quantities and kinds of such material and the levels of radioactivity involved, and the proposed manner and conditions of disposal. The application should also include an analysis and evaluation of pertinent information as to the nature of the environment, including topographical, geological, meteorological, and hydrological characteristics; usage of ground and surface waters in the general area; the nature and location of other potentially affected facilities; and procedures to be observed to minimize the risk of unexpected or hazardous exposures.

(b) The Commission will not approve any application for a license for disposal of licensed material at sea unless the applicant shows that sea disposal offers less harm to man or the environment than other practical alternative methods of disposal.

[25 FR 10914, Nov. 17, 1960, as amended at 26 FR 352, Jan. 18, 1961; 36 FR 23138, Dec. 4, 1971; 47 FR 57479, Dec. 27, 1982]

§ 20.303 Disposal by release into sanitary sewerage systems.

No licensee shall discharge licensed material into a sanitary sewerage system unless:

(a) It is readily soluble or dispersible in water; and

(b) The quantity of any licensed or other radioactive material released into the system by the licensee in any one day does not exceed the larger of paragraphs (b)(1) or (2) of this section.

(1) The quantity which, if diluted by the average daily quantity of sewage released into the sewer by the licensee, will result in an average concentration equal to the limits specified in Appendix B, Table I, Column 2 of this part; or

(2) Ten times the quantity of such material specified in Appendix C of this part; and

(c) The quantity of any licensed or other radioactive material released in any one month, if diluted by the average monthly quantity of water released by the licensee, will not result in an average concentration exceeding the limits specified in Appendix B, Table I, Column 2 of this part; and

(d) The gross quantity of licensed and other radioactive material, excluding hydrogen-3 and carbon-14, released into the sewerage system by the licensee does not exceed one curie per year. The quantities of hydrogen-3 and carbon-14 released into the sanitary sewerage system may not exceed 5 curies per year for hydrogen-3 and 1 curie per year for carbon-14. Excreta from individuals undergoing medical diagnosis or therapy with radioactive material shall be exempt from any limitations contained in this section.

(25 FR 10914, Nov. 17, 1960, as amended at 46 FR 16234, Mar. 11, 1981)

§ 20.305 Treatment or disposal by incineration.

No licensee shall treat or dispose of licensed material by incineration except for materials listed under § 20.306 or as specifically approved by the Commission pursuant to §§ 20.106(b) and 20.302.

(46 FR 16234, Mar. 11, 1981)

§ 20.306 Disposal of specific wastes.

Any licensee may dispose of the following licensed material without regard to its radioactivity:

(a) 0.05 microcuries or less of hydrogen-3 or carbon-14, per gram of medium, used for liquid scintillation counting; and

(b) 0.05 microcuries or less of hydrogen-3 or carbon-14, per gram of animal tissue averaged over the weight of the entire animal; provided however, tissue may not be disposed of under this section in a manner that would permit its use either as food for humans or as animal feed.

(c) Nothing in this section, however, relieves the licensee of maintaining records showing the receipt, transfer and disposal of such byproduct materi-

al as specified in § 30.51 of this chapter; and

(d) Nothing in this section relieves the licensee from complying with other applicable Federal, State and local regulations governing any other toxic or hazardous property of these materials.

(46 FR 16234, Mar. 11, 1981)

§ 20.311 Transfer for disposal and manifests.

(a) *Purpose.* The requirements of this section are designed to control transfers of radioactive waste intended for disposal at a land disposal facility and establish a manifest tracking system and supplement existing requirements concerning transfers and recordkeeping for such wastes. The reporting and recordkeeping requirements contained in this section have been approved by the Office of Management and Budget; OMB approval No. 3150-0014.

(b) Each shipment of radioactive waste to a licensed land disposal facility must be accompanied by a shipment manifest that contains the name, address, and telephone number of the person generating the waste. The manifest shall also include the name, address, and telephone number or the name and EPA hazardous waste identification number of the person transporting the waste to the land disposal facility. The manifest must also indicate as completely as practicable: a physical description of the waste; the volume; radionuclide identity and quantity; the total radioactivity; and the principal chemical form. The solidification agent must be specified. Waste containing more than 0.1% chelating agents by weight must be identified and the weight percentage of the chelating agent estimated. Wastes classified as Class A, Class B, or Class C in § 61.55 of this chapter must be clearly identified as such in the manifest. The total quantity of the radionuclides H-3, C-14, Tc-99 and I-129 must be shown. The manifest required by this paragraph may be shipping papers used to meet Department of Transportation or Environmental Protection Agency regulations or requirements of the receiver, provided all the

required information is included. Copies of manifests required by this section may be legible carbon copies or legible photocopies.

(c) Each manifest must include a certification by the waste generator that the transported materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the Commission. An authorized representative of the waste generator shall sign and date the manifest.

(d) Any generating licensee who transfers radioactive waste to a land disposal facility or a licensed waste collector shall comply with the requirements in paragraphs (d)(1) through (8) of this section. Any generating licensee who transfers waste to a licensed waste processor who treats or repackages waste shall comply with the requirements of paragraphs (d)(4) through (8) of this section. A licensee shall:

(1) Prepare all wastes so that the waste is classified according to § 61.55 and meets the waste characteristics requirements in § 61.56 of this chapter;

(2) Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with § 61.55 of this chapter;

(3) Conduct a quality control program to assure compliance with §§ 61.55 and 61.56 of this chapter; the program must include management evaluation of audits;

(4) Prepare shipping manifests to meet the requirements of §§ 20.311 (b) and (c) of this part;

(5) Forward a copy of the manifest to the intended recipient, at the time of shipment; or, deliver to a collector at the time the waste is collected, obtaining acknowledgement of receipt in the form of a signed copy of the manifest or equivalent documentation from the collector;

(6) Include one copy of the manifest with the shipment;

(7) Retain a copy of the manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by Parts 30, 40, and 70 of this chapter; and,

(8) For any shipments or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this section, conduct an investigation in accordance with paragraph (h) of this section.

(e) Any waste collector licensee who handles only prepackaged waste shall:

(1) Acknowledge receipt of the waste from the generator within one week of receipt by returning a signed copy of the manifest or equivalent documentation;

(2) Prepare a new manifest to reflect consolidated shipments; the new manifest shall serve as a listing or index for the detailed generator manifests. Copies of the generator manifests shall be a part of the new manifest. The waste collector may prepare a new manifest without attaching the generator manifests, provided the new manifest contains for each package the information specified in paragraph (b) of this section. The collector licensee shall certify that nothing has been done to the waste which would invalidate the generator's certification;

(3) Forward a copy of the new manifest to the land disposal facility operator at the time of shipment;

(4) Include the new manifest with the shipment to the disposal site;

(5) Retain a copy of the manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by Parts 30, 40, and 70 of this chapter, and retain information from generator manifests until disposition is authorized by the Commission; and,

(6) For any shipments or any part of a shipment for which acknowledgement of receipt is not received within the times set forth in this section, conduct an investigation in accordance with paragraph (h) of this section.

(f) Any licensed waste processor who treats or repackages wastes shall:

(1) Acknowledge receipt of the waste from the generator within one week of receipt by returning a signed copy of the manifest or equivalent documentation;

(2) Prepare a new manifest that meets the requirements of paragraphs (b) and (c) of this section. Preparation

of the new manifest reflects that the processor is responsible for the waste;

(3) Prepare all wastes so that the waste is classified according to § 61.55 and meets the waste characteristics requirements in § 61.56 of this chapter;

(4) Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with §§ 61.55 and 61.57 of this chapter;

(5) Conduct a quality control program to assure compliance with §§ 61.55 and 61.56 of this chapter. The program shall include management evaluation of audits;

(6) Forward a copy of the new manifest to the disposal site operator or waste collector at the time of shipment, or deliver to a collector at the time the waste is collected, obtaining acknowledgement of receipt in the form of a signed copy of the manifest or equivalent documentation by the collector;

(7) Include the new manifest with the shipment;

(8) Retain copies of original manifests and new manifests and documentation of acknowledgement of receipt as the record of transfer of licensed material required by Parts 30, 40, and 70 of this chapter; and

(9) For any shipment or part of a shipment for which acknowledgement is not received within the times set forth in this section, conduct an investigation in accordance with paragraph (h) of this section.

(g) The land disposal facility operator shall:

(1) Acknowledge receipt of the waste within one week of receipt by returning a signed copy of the manifest or equivalent documentation to the shipper. The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the operator. The returned copy of the manifest or equivalent documentation shall indicate any discrepancies between materials listed on the manifest and materials received;

(2) Maintain copies of all completed manifests or equivalent documentation until the Commission authorizes their disposition; and

(3) Notify the shipper (i.e., the generator, the collector, or processor) and

the Regional Administrator of the nearest Commission Regional Office listed in Appendix D of this part when any shipment or part of a shipment has not arrived within 60 days after the advance manifest was received.

(h) Any shipment or part of a shipment for which acknowledgement is not received within the times set forth in this section, must:

(1) Be investigated by the shipper if the shipper has not received notification of receipt within 20 days after transfer; and

(2) Be traced and reported. The investigation shall include tracing the shipment and filing a report with the nearest Commission Regional Office listed in Appendix D of this part. Each licensee who conducts a trace investigation shall file a written report with the nearest Commission's Regional office within 2 weeks of completion of the investigation.

[47 FR 57479, Dec. 27, 1982, as amended at 53 FR 17689, May 18, 1988]

RECORDS, REPORTS, AND NOTIFICATION

§ 20.401 Records of surveys, radiation monitoring, and disposal.

(a) Each licensee shall maintain records showing the radiation exposures of all individuals for whom personnel monitoring is required under § 20.202 of the regulations in this part. Such records shall be kept on Form NRC-5, in accordance with the instructions contained in that form or on clear and legible records containing all the information required by Form NRC-5. The doses entered on the forms or records shall be for periods of time not exceeding one calendar quarter.

(b) Each licensee shall maintain records in the same units used in this part, showing the results of surveys required by § 20.201(b), monitoring required by §§ 20.205(b) and 20.205(c), and disposals made under §§ 20.302, 20.303, removed § 20.304,¹ and Part 61 of this chapter.

¹Section 20.304 provided for burial of small quantities of licensed materials in soil. Notice of its removal appears in the FEDERAL REGISTER of October 30, 1980 (45 FR 71762).

(c)(1) Records of individual exposure to radiation and to radioactive material which must be maintained pursuant to the provisions of paragraph (a) of this section and records of bioassays, including results of whole body counting examinations, made pursuant to § 20.108, shall be preserved until the Commission authorizes disposition.

(2) Records of the results of surveys and monitoring which must be maintained pursuant to paragraph (b) of this section shall be preserved for two years after completion of the survey except that the following records shall be maintained until the Commission authorizes their disposition: (i) Records of the results of surveys to determine compliance with § 20.103(a); (ii) in the absence of personnel monitoring data, records of the results of surveys to determine external radiation dose; and (iii) records of the results of surveys used to evaluate the release of radioactive effluents to the environment.

(3) Records of disposal of licensed materials made pursuant to §§ 20.302, 20.303, removed § 20.304,¹ and Part 61 of this chapter are to be maintained until the Commission authorizes their disposition.

(4) Records which must be maintained pursuant to this part may be the original or a reproduced copy or microform if such reproduced copy or microform is duly authenticated by authorized personnel and the microform is capable of producing a clear and legible copy after storage for the period specified by Commission regulations.

(5) If there is a conflict between the Commission's regulations in this part, license condition, or technical specification, or other written Commission approval or authorization pertaining to the retention period for the same type of record, the retention period specified in the regulations in this part for such records shall apply unless the Commission pursuant to § 20.501, has granted a specific exemption from the record retention requirements specified in the regulations in this part.

¹See footnote 1 to paragraph (b) of this section.

[25 FR 10914, Nov. 17, 1960, as amended at 41 FR 18301, May 3, 1976; 47 FR 57480, Dec. 27, 1982]

§ 20.402 Reports of theft or loss of licensed material.

(a)(1) Each licensee shall report to the Commission, by telephone, immediately after it determines that a loss or theft of licensed material has occurred in such quantities and under such circumstances that it appears to the licensee that a substantial hazard may result to persons in unrestricted areas.

(2) Reports must be made as follows:

(i) Licensees having an installed Emergency Notification System shall make the reports to the NRC Operations Center in accordance with § 50.72 of this chapter.

(ii) All other licensees shall make reports to the Administrator of the appropriate NRC Regional Office listed in Appendix D of this part.

(b) Each licensee who makes a report under paragraph (a) of this section shall, within 30 days after learning of the loss or theft, make a report in writing to the U.S. Nuclear Regulatory Commission, Document Control Desk, Washington, DC 20555, with a copy to the appropriate NRC Regional Office listed in Appendix D of this part. The report shall include the following information:

(1) A description of the licensed material involved, including kind, quantity, chemical, and physical form;

(2) A description of the circumstances under which the loss or theft occurred;

(3) A statement of disposition or probable disposition of the licensed material involved;

(4) Radiation exposures to individuals, circumstances under which the exposures occurred, and the extent of possible hazard to persons in unrestricted areas;

(5) Actions which have been taken, or will be taken, to recover the material; and

(6) Procedures or measures which have been or will be adopted to prevent a recurrence of the loss or theft of licensed material.

(c) Subsequent to filing the written report the licensee shall also report

any substantive additional information on the loss or theft which becomes available to the licensee, within 30 days after he learns of such information.

(d) Any report filed with the Commission pursuant to this section shall be so prepared that names of individuals who may have received exposure to radiation are stated in a separate part of the report.

(e) For holders of an operating license for a nuclear power plant, the events included in paragraph (b) of this section must be reported in accordance with the procedures described in § 50.73 (b), (c), (d), (e), and (g) of this chapter and must include the information required in paragraph (b) of this section. Events reported in accordance with § 50.73 of this chapter need not be reported by a duplicate report under paragraph (b) of this section.

[34 FR 7500, May 9, 1969, as amended at 38 FR 1271, Jan. 11, 1973; 48 FR 33859, July 26, 1983]

§ 20.403 Notifications of incidents.

(a) *Immediate notification.* Each licensee shall immediately report any events involving byproduct, source, or special nuclear material possessed by the licensee that may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 25 rems or more of radiation; exposure of the skin of the whole body of any individual of 150 rems or more of radiation; or exposure of the feet, ankles, hands or forearms of any individual to 375 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in Appendix B, Table II of this part.

(b) *Twenty-four hour notification.* Each licensee shall within 24 hours of discovery of the event, report any event involving licensed material possessed by the licensee that may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body of any individual to 30

rems or more of radiation; or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limits specified for such materials in Appendix B, Table II of this part.

(c) Any report filed with the Commission pursuant to this section shall be prepared so that names of individuals who have received exposure to radiation will be stated in a separate part of the report.

(d) Reports made by licensees in response to the requirements of this section must be made as follows:

(1) Licensees that have an installed Emergency Notification System shall make the reports required by paragraphs (a) and (b) of this section to the NRC Operations Center in accordance with § 50.72 of this chapter.

(2) All other licensees shall make the reports required by paragraphs (a) and (b) of this section by telephone to the NRC Operations Center¹ and by telegram, mailgram, or facsimile to the Administrator of the appropriate NRC Regional Office listed in Appendix D of this part.

[27 FR 5905, June 22, 1962, as amended at 28 FR 6823, July 3, 1963; 42 FR 43965, Sept. 1, 1977; 43 FR 2719, Jan. 19, 1978; 48 FR 33859, July 26, 1983; 52 FR 33917, Sept. 9, 1987; 56 FR 944, Jan. 10, 1991; 56 FR 40766, Aug. 16, 1991]

§ 20.404 [Reserved]

§ 20.405 Reports of overexposures and excessive levels and concentrations.

(a)(1) In addition to any notification required by § 20.403 of this part, each licensee shall make a report in writing concerning any one of the following types of incidents within 30 days of its occurrence:

(i) Each exposure of an individual to radiation in excess of the applicable limits in §§ 20.101 or 20.104(a) of this part, or the license;

(ii) Each exposure of an individual to radioactive material in excess of the

¹ Commercial telephone number of the NRC Operations Center is (301) 951-0550.

applicable limits in §§ 20.103(a)(1), 20.103(a)(2), or § 20.104(b) of this part, or in the license;

(iii) Levels of radiation or concentrations of radioactive material in a restricted area in excess of any other applicable limit in the license;

(iv) Any incident for which notification is required by § 20.403 of this part; or

(v) Levels of radiation or concentrations of radioactive material (whether or not involving excessive exposure of any individual) in an unrestricted area in excess of ten times any applicable limit set forth in this part or in the license.

(2) Each report required under paragraph (a)(1) of this section must describe the extent of exposure of individuals to radiation or to radioactive material, including:

(i) Estimates of each individual's exposure as required by paragraph (b) of this section;

(ii) Levels of radiation and concentrations of radioactive material involved;

(iii) The cause of the exposure, levels or concentrations; and

(iv) Corrective steps taken or planned to prevent a recurrence.

(b) Any report filed with the Commission pursuant to paragraph (a) of this section shall include for each individual exposed the name, social security number, and date of birth, and an estimate of the individual's exposure. The report shall be prepared so that this information is stated in a separate part of the report.

(c)(1) In addition to any notification required by § 20.403 of this part, each licensee shall make a report in writing of levels of radiation or releases of radioactive material in excess of limits specified by 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations," or in excess of license conditions related to compliance with 40 CFR Part 190.

(2) Each report submitted under paragraph (c)(1) of this section must describe:

(i) The extent of exposure of individuals to radiation or to radioactive material;

(ii) Levels of radiation and concentrations of radioactive material involved;

(iii) The cause of the exposure, levels, or concentrations; and

(iv) Corrective steps taken or planned to assure against a recurrence, including the schedule for achieving conformance with 40 CFR Part 190 and with associated license conditions.

(d) For holders of an operating license for a nuclear power plant, the incidents included in paragraphs (a) or (c) of this section must be reported in accordance with the procedures described in § 50.73 (b), (c), (d), (e), and (g) of this chapter and must also include the information required by paragraphs (a) and (c) of this section. Incidents reported in accordance with § 50.73 of this chapter need not be reported by a duplicate report under paragraphs (a) or (c) of this section.

(e) All other licensees who make reports under paragraphs (a) or (c) of this section shall, within 30 days after learning of the overexposure or excessive level or concentration, make a report in writing to the U.S. Nuclear Regulatory Commission, Document Control Desk, Washington, D.C. 20555, with a copy to the appropriate NRC Regional Office listed in Appendix D of this part.

[25 FR 10914, Nov. 17, 1960, as amended at 35 FR 15068, Sept. 29, 1970; 46 FR 18526, Mar. 25, 1981; 48 FR 33860, July 26, 1983]

§ 20.406 [Reserved]

§ 20.407 Personnel monitoring reports.

Each person described in § 20.408 of this part shall, within the first quarter of each calendar year, submit to the Director, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, the reports specified in paragraphs (a) and (b) of this section, covering the preceding calendar year.¹

¹ A licensee whose license expires or terminates prior to, or on the last day of the calendar year, shall submit reports at the expiration or termination of the license, covering that part of the year during which the license was in effect.

(a) A report of either (1) the total number of individuals for whom personnel monitoring was required under § 20.202(a) or § 34.33(a) of this chapter during the calendar year; or (2) the total number of individuals for whom personnel monitoring was provided during the calendar year: *Provided, however,* That such total includes at least the number of individuals required to be reported under paragraph (a)(1) of this section. The report shall indicate whether it is submitted in accordance with paragraph (a)(1) or (a)(2) of this section. If personnel monitoring was not required to be provided to any individual by the licensee under §§ 20.202(a) or 34.33(a) of this chapter during the calendar year, the licensee shall submit a negative report indicating that such personnel monitoring was not required.

(b) A statistical summary report of the personnel monitoring information recorded by the licensee for individuals for whom personnel monitoring was either required or provided, as described in paragraph (a) of this section, indicating the number of individuals whose total whole body exposure recorded during the previous calendar year was in each of the following estimated exposure ranges:

Estimated whole body exposure range (rems) ¹	Number of individuals in each range
No measurable exposure	
Measurable exposure less than 0.1	
0.1 to 0.25	
0.25 to 0.5	
0.5 to 0.75	
0.75 to 1	
1 to 2	
2 to 3	
3 to 4	
4 to 5	
5 to 6	
6 to 7	
7 to 8	
8 to 9	
9 to 10	
10 to 11	
11 to 12	
12 +	

¹Individual values exactly equal to the values separating exposure ranges shall be reported in the higher range.

The low exposure range data are required in order to obtain better information about the exposures actually

recorded. This section does not require improved measurements.

[43 FR 44829, Sept. 29, 1978, as amended at 49 FR 24513, June 14, 1984]

§ 20.408 Reports of personnel monitoring on termination of employment or work.

(a) This section applies to each person licensed by the Commission to:

(1) Operate a nuclear reactor designed to produce electrical or heat energy pursuant to § 50.21(b) or § 50.22 of this chapter or a testing facility as defined in § 50.2 of this chapter.

(2) Possess or use byproduct material for purposes of radiography pursuant to Parts 30 and 34 of this chapter;

(3) Possess or use at any one time, for purposes of fuel processing, fabricating, or reprocessing, special nuclear material in a quantity exceeding 5,000 grams of contained uranium-235, uranium-233, or plutonium or any combination thereof pursuant to Part 70 of this chapter;

(4) Possess high-level radioactive waste at a geologic repository operations area pursuant to Part 60 of this chapter; or

(5) Possess spent fuel in an independent spent fuel storage installation (ISFSI) or possess spent fuel or high level radioactive waste in a monitored retrievable storage installation (MRS) pursuant to Part 72 of this chapter; or

(6) Possess or use at any one time, for processing or manufacturing for distribution pursuant to Parts 30, 32, or 33 of this Chapter, byproduct material in quantities exceeding any one of the following quantities:

Radionuclide ¹	Quantity in curies
Cesium-137	1
Cobalt-60	1
Gold-198	100
Iodine-131	1
Indium-192	10
Krypton-85	1,000
Promethium-147	10
Technetium-99m	1,000

¹The Commission may require, as a license condition, or by rule, regulation or order pursuant to § 20.502, reports from licensees who are licensed to use radionuclides not on this list, in quantities sufficient to cause comparable radiation levels.

(7) Receive radioactive waste from other persons for disposal under Part 61 of this chapter.

(b) When an individual terminates employment with a licensee described in paragraph (a) of this section, or an individual assigned to work in such a licensee's facility, but not employed by the licensee, completes the work assignment in the licensee's facility, the licensee shall furnish to the REIRS Project Manager, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, a report of the individual's exposures to radiation and radioactive material, incurred during the period of employment or work assignment in the licensee's facility, containing information recorded by the licensee pursuant to §§ 20.401(a) and 20.108. Such report shall be furnished within 30 days after the exposure of the individual has been determined by the licensee or 90 days after the date of termination of employment or work assignment, whichever is earlier.

[43 FR 44829, Sept. 29, 1978, as amended at 46 FR 13978, Feb. 25, 1981; 46 FR 58282, Dec. 1, 1981; 47 FR 57480, Dec. 27, 1982; 49 FR 24513, June 14, 1984; 50 FR 34085, Aug. 23, 1985; 53 FR 31680, Aug. 19, 1988; 56 FR 32072, July 15, 1991]

§ 20.409 Notifications and reports to individuals.

(a) Requirements for notifications and reports to individuals of exposure to radiation or radioactive material are specified in § 19.13 of this chapter.

(b) When a licensee is required pursuant to §§ 20.405 or 20.408 to report to the Commission any exposure of an individual to radiation or radioactive material, the licensee shall also notify the individual. Such notice shall be transmitted at a time not later than the transmittal to the Commission, and shall comply with the provisions of § 19.13(a) of this chapter.

[38 FR 22220, Aug. 17, 1973]

EXCEPTIONS AND ADDITIONAL REQUIREMENTS

§ 20.501 Applications for exemptions.

The Commission may, upon application by any licensee or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not result in undue hazard to life or property.

§ 20.502 Additional requirements.

The Commission may, by rule, regulation, or order, impose upon any licensee such requirements, in addition to those established in the regulations in this part, as it deems appropriate or necessary to protect health or to minimize danger to life or property.

ENFORCEMENT

§ 20.601 Violations.

An injunction or other court order may be obtained prohibiting any violation of any provision of the Atomic Energy Act of 1954, as amended, or Title II of the Energy Reorganization Act of 1974, or any regulation or order issued thereunder. A court order may be obtained for the payment of a civil penalty imposed pursuant to section 234 of the Act for violation of section 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Act, or section 206 of the Energy Reorganization Act of 1974, or any rule, regulation, or order issued thereunder, or any term, condition, or limitation of any license issued thereunder, or for any violation for which a license may be revoked under section 186 of the Act. Any person who willfully violates any provision of the Act or any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

[40 FR 8784, Mar. 3, 1975]

APPENDIX A TO §§ 20.1—20.601—PROTECTION FACTORS FOR RESPIRATORS *

Description *	Modes *	Protection factors *		Tested and certified equipment— National Institute for Occupational Safety and Health/Mine Safety and Health Administration tests for permissibility
		Particulates only	Particu- lates, gases and vapors *	
I. Air-purifying respirators.†				
Facepiece, half-mask *	NP	10		30 CFR Part 11, Subpart K.
Facepiece, full	NP	50		
Facepiece, half-mask, full, or hood	PP	1,000		
II. Atmosphere-supplying respirators				
1. Air-line respirator:				
Facepiece, half-mask	CF		1,000	30 CFR Part 11, Subpart J.
Facepiece, half-mask	D		5	
Facepiece, full	CF		2,000	
Facepiece, full	D		5	
Facepiece, full	PD		2,000	
Hood	CF		(†)	
Suit	CF		(†)	
2. Self-contained breathing ap- paratus (SCBA):				
Facepiece, full	D		50	30 CFR Part 11, Subpart H.
Facepiece, full	PD		* 10,000	
Facepiece, full	RD		50	
Facepiece, full	RP		* 5,000	
III. Combination respirator: Any com- bination of air-purifying and atmos- phere-supplying respirators.			=	30 CFR Part 11, § 11.63(b).

* For use in the selection of respiratory protective devices to be used only where the contaminants have been identified and the concentrations (or possible concentrations) are known.

* Only for shaven faces and where nothing interferes with the seal of tightfitting facepieces against the skin. (Hoods and suits are excepted.)

* The mode symbols are defined as follows: CF=continuous flow; D=demand; NP=negative pressure (i.e., negative phase during inhalation); PD=pressure demand (i.e., always positive pressure); PP=positive pressure; RD=demand, recirculating (closed circuit); RP=positive pressure, recirculating (closed circuit).

*†† The protection factor is a measure of the degree of protection afforded by a respirator, defined as the ratio of the concentration of airborne radioactive material outside the respiratory protective equipment to that inside the equipment (usually inside the facepiece) under conditions of use. It is applied to the ambient airborne concentration to estimate the concentrations inhaled by the wearer according to the following formula:

$$\text{Concentration inhaled} = (\text{Ambient airborne concentration})/(\text{Protection factor})$$

*††† The protection factors apply:

(a) Only for trained individuals wearing properly fitted respirators used and maintained under supervision in a well-planned respiratory protective program.

(b) For air-purifying respirators only when high efficiency particulate filters (above 99.97% removal efficiency by thermally generated 0.3 µm dioctyl phthalate (DOP) test) are used in atmospheres not deficient in oxygen and not containing radioactive gas or vapor respiratory hazards.

(c) No allowance is to be made for the use of sorbents against radioactive gases or vapors.

(d) For atmosphere-supplying respirators only when supplied with adequate respirable air. Respirable air shall be provided of the quality and quantity required in accordance with NIOSH/MSHA certification (described in 30 CFR Part 11). Oxygen and air shall not be used in the same apparatus.

* Excluding radioactive contaminants that present an absorption or submersion hazard. For tritium oxide, approximately one half of the intake occurs by absorption through the skin so that an overall protection factor of less than 2 is appropriate when atmosphere-supplying respirators are used to protect against tritium oxide. If the protection factor for a device is 5, the effective protection factor for tritium is about 1.4; for devices with protection factors of 10 the effective factor for tritium oxide is about 1.7; and for devices with protection factors of 100 or more the effective factor for tritium oxide is about 1.9. Air-purifying respirators are not suitable for protection against tritium oxide. See also footnote i concerning supplied-air suits.

* Canisters and cartridges shall not be used beyond service-life limitations.

* Under-chin type only. This type of respirator is not satisfactory for use where it might be possible (e.g., if an accident or emergency were to occur) for the ambient airborne concentration to reach instantaneous values greater than 10 times the permanent values in Table 1, Column 1 of Appendix B of this part. This type of respirator is not suitable for protection against plutonium or other high-toxicity materials. The mask shall be tested for fit with irritant smoke, prior to use, each time it is donned.

* Equipment shall be operated in a manner that ensures that proper air flow-rates are maintained. A protection factor of no more than 1000 may be used for tested-and-certified supplied-air hoods when a minimum air flow of 6 cubic feet per minute is maintained and calibrated airline pressure gauges or flow measuring devices are used. A protection factor of up to 2000 may be used for tested and certified hoods only when the air flow is maintained at the manufacturer's recommended maximum rate for the equipment, this rate is greater than 6 cubic feet per minute, and calibrated airline pressure gauges or flow measuring devices are used.

The design of the supplied-air hood or helmet (with a minimum flow of 6 cfm of air) may determine its overall efficiency and the protection it provides. For example, some hoods aspirate contaminated air into the breathing zone when the wearer works with hands-over-head. This aspiration may be overcome if a short cape-like extension to the hood is worn under a coat or overalls. Other limitations specified by the approval agency shall be considered before using a hood in certain types of atmospheres, such as the design and its permeability to the contaminant under conditions of use.

* Appropriate protection factors shall be determined (see 20.103(e)), taking into account the design of the suit and its permeability to the contaminant under conditions of use. There shall be a standby rescue person equipped with self-contained breathing apparatus and communications equipment whenever supplied-air suits are used.

*No approval schedules are currently available for this equipment. Equipment shall be evaluated by testing or on the basis of reliable test information.

* This type of respirator may provide greater protection and be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure such as skin absorption shall be taken into account in these circumstances.

*Quantitative fit testing shall be performed on each individual and no more than 0.02% leakage is allowed with this type of apparatus. Perceptible outward leakage of gas from this or any positive pressure self-contained breathing apparatus is unacceptable because service life will be reduced substantially. Special training in the use of this type of apparatus shall be provided to the wearer (see footnote k).

* Protection factor for type and mode of operation as listed above.

NOTE 1: Protection factors for respirators, as may be approved by the U.S. Bureau of Mines/National Institute for Occupational Safety and Health (NIOSH) according to applicable approvals for respirators for type and mode of use to protect against airborne radionuclides, may be used to the extent that they do not exceed the protection factors listed in this table. The protection factors listed in this table may not be appropriate to circumstances where chemical or other respiratory hazards exist in addition to radiological hazards. The selection and use of respirators for these circumstances should take into account applicable approvals of the U.S. Bureau of Mines/NIOSH.

NOTE 2: Radioactive contaminants for which the concentration values in Table 1, column 1, Appendix B of this part are based on internal dose due to inhalation may, in addition, present external exposure hazards at higher concentrations. Under these circumstances, limitations on occupancy may have to be governed by external dose limits.

[47 FR 16165, Apr. 15, 1982; 47 FR 19511, May 6, 1982. Redesignated at 56 FR 23391, May 21, 1991]

APPENDIX B TO §§ 20.1—20.601—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL
BACKGROUND

(See footnotes at end of Appendix B)

Element (atomic number)	Isotope ¹		Table I		Table II	
			Col. 1—Air ($\mu\text{Ci}/\text{m}^3$)	Col. 2— Water ($\mu\text{Ci}/\text{m}^3$)	Col. 1—Air ($\mu\text{Ci}/\text{m}^3$)	Col. 2— Water ($\mu\text{Ci}/\text{m}^3$)
Actinium (89)	Ac 227	S	$2 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$3 \cdot 10^{-11}$	$9 \cdot 10^{-11}$	$9 \cdot 10^{-12}$	$3 \cdot 10^{-11}$
	Ac 228	S	$8 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
		I	$2 \cdot 10^{-11}$	$3 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
Americium (95)	Am 241	S	$6 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$2 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
		I	$1 \cdot 10^{-11}$	$8 \cdot 10^{-11}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-11}$
	Am 242m	S	$6 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$2 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
		I	$5 \cdot 10^{-11}$	$3 \cdot 10^{-12}$	$9 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
	Am 242	S	$4 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$1 \cdot 10^{-11}$
		I	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-11}$	$1 \cdot 10^{-11}$
	Am 243	S	$6 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$2 \cdot 10^{-11}$	$4 \cdot 10^{-12}$
		I	$1 \cdot 10^{-11}$	$8 \cdot 10^{-11}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-11}$
Antimony	Am 244	S	$4 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$1 \cdot 10^{-11}$	$5 \cdot 10^{-12}$
		I	$2 \cdot 10^{-11}$	$1 \cdot 10^{-11}$	$8 \cdot 10^{-11}$	$5 \cdot 10^{-12}$
	Sb 122	S	$2 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		I	$1 \cdot 10^{-11}$	$8 \cdot 10^{-11}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-11}$
	Sb 124	S	$2 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Argon (18)		I	$2 \cdot 10^{-11}$	$7 \cdot 10^{-11}$	$7 \cdot 10^{-12}$	$2 \cdot 10^{-11}$
	Sb 125	S	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-11}$	$1 \cdot 10^{-11}$
		I	$3 \cdot 10^{-11}$	$3 \cdot 10^{-12}$	$9 \cdot 10^{-12}$	$1 \cdot 10^{-11}$
	A 37	Sub ²	$6 \cdot 10^{-12}$		$1 \cdot 10^{-11}$	
	A 41	Sub	$2 \cdot 10^{-11}$		$4 \cdot 10^{-12}$	
Arsenic (33)	As 73	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$5 \cdot 10^{-12}$
		I	$4 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$5 \cdot 10^{-12}$
	As 74	S	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$5 \cdot 10^{-12}$
		I	$1 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$5 \cdot 10^{-12}$
	As 76	S	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Astatine (85)	As 77	S	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$8 \cdot 10^{-12}$
		I	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$8 \cdot 10^{-12}$
	At 211	S	$7 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$2 \cdot 10^{-11}$	$2 \cdot 10^{-12}$
		I	$3 \cdot 10^{-11}$	$2 \cdot 10^{-11}$	$1 \cdot 10^{-11}$	$7 \cdot 10^{-12}$
Barium (56)	Ba 131	S	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$4 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$2 \cdot 10^{-12}$
	Ba 140	S	$1 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
Berkelium (97)		I	$4 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$2 \cdot 10^{-12}$
	Bk 249	S	$9 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
		I	$1 \cdot 10^{-11}$	$2 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$6 \cdot 10^{-12}$

APPENDIX B TO §§ 20.1—20.601—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL
BACKGROUND—Continued

(See footnotes at end of Appendix B)

Element (atomic number)	Isotope ¹		Table I		Table II	
			Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)	Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)
Beryllium (4)	Bk 250	S	$1 \cdot 10^{-12}$	$6 \cdot 10^{-14}$	$5 \cdot 10^{-13}$	$2 \cdot 10^{-14}$
	I		$1 \cdot 10^{-12}$	$6 \cdot 10^{-14}$	$4 \cdot 10^{-13}$	$2 \cdot 10^{-14}$
Bismuth (83)	Be 7	S	$6 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-13}$
	I		$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$4 \cdot 10^{-13}$	$2 \cdot 10^{-13}$
Bismuth (83)	Bi 206	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-13}$	$4 \cdot 10^{-13}$
	I		$1 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$5 \cdot 10^{-13}$	$4 \cdot 10^{-13}$
Bismuth (83)	Bi 207	S	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$6 \cdot 10^{-13}$	$6 \cdot 10^{-13}$
	I		$1 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$5 \cdot 10^{-13}$	$6 \cdot 10^{-13}$
Bismuth (83)	Bi 210	S	$6 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$4 \cdot 10^{-13}$
	I		$6 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$4 \cdot 10^{-13}$
Bismuth (83)	Bi 212	S	$1 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$4 \cdot 10^{-13}$
	I		$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-13}$	$4 \cdot 10^{-13}$
Bromine (35)	Br 82	S	$1 \cdot 10^{-12}$	$8 \cdot 10^{-13}$	$4 \cdot 10^{-13}$	$3 \cdot 10^{-13}$
	I		$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-13}$	$4 \cdot 10^{-13}$
Cadmium (48)	Cd 109	S	$5 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-13}$
	I		$7 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-13}$
Cadmium (48)	Cd 115m	S	$4 \cdot 10^{-12}$	$7 \cdot 10^{-13}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-13}$
	I		$4 \cdot 10^{-12}$	$7 \cdot 10^{-13}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-13}$
Cadmium (48)	Cd 115	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$8 \cdot 10^{-13}$	$3 \cdot 10^{-13}$
	I		$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-13}$	$4 \cdot 10^{-13}$
Calcium (20)	Ca 45	S	$3 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$9 \cdot 10^{-13}$
	I		$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Calcium (20)	Ca 47	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$5 \cdot 10^{-12}$
	I		$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
Californium (98)	Cf 249	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
	I		$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Californium (98)	Cf 250	S	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	I		$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
Californium (98)	Cf 251	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
	I		$1 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
Californium (98)	Cf 252	S	$6 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$7 \cdot 10^{-12}$
	I		$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$
Californium (98)	Cf 253	S	$8 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	I		$8 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
Californium (98)	Cf 254	S	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	I		$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
Carbon (6)	C 14	S	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$8 \cdot 10^{-12}$
	(CO ₂)	Sub	$5 \cdot 10^{-12}$		$1 \cdot 10^{-12}$	
Cerium (58)	Ce 141	S	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
	I		$2 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
Cerium (58)	Ce 143	S	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$9 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
	I		$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
Cerium (58)	Ce 144	S	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	I		$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
Cesium (55)	Cs 131	S	$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	I		$3 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
Cesium (55)	Cs 134m	S	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
	I		$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
Cesium (55)	Cs 134	S	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
	I		$1 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
Cesium (55)	Cs 135	S	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	I		$9 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Cesium (55)	Cs 136	S	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
	I		$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
Cesium (55)	Cs 137	S	$6 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	I		$1 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
Chlorine (17)	Cl 36	S	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$8 \cdot 10^{-12}$
	I		$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
Chlorine (17)	Cl 38	S	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$9 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
	I		$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
Chromium (24)	Cr 51	S	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	I		$2 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Cobalt (27)	Co 57	S	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$
	I		$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$4 \cdot 10^{-12}$

APPENDIX B TO §§ 20.1—20.601—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL
BACKGROUND—Continued

[See footnotes at end of Appendix B]

Element (atomic number)	Isotope *		Table I		Table II	
			Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)	Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)
Copper (29)	Co 58m	S	$2 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-11}$
		I	$9 \cdot 10^{-10}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	Co 58	S	$8 \cdot 10^{-11}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-10}$	$1 \cdot 10^{-11}$
		I	$5 \cdot 10^{-10}$	$3 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$9 \cdot 10^{-12}$
Copper (29)	Co 60	S	$3 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$1 \cdot 10^{-11}$	$5 \cdot 10^{-12}$
		I	$9 \cdot 10^{-10}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-10}$	$3 \cdot 10^{-12}$
	Cu 64	S	$2 \cdot 10^{-10}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-10}$	$3 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
Curium (96)	Cm 242	S	$1 \cdot 10^{-10}$	$7 \cdot 10^{-11}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$2 \cdot 10^{-10}$	$7 \cdot 10^{-11}$	$6 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	Cm 243	S	$6 \cdot 10^{-12}$	$1 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$5 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$7 \cdot 10^{-11}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Curium (96)	Cm 244	S	$9 \cdot 10^{-12}$	$2 \cdot 10^{-11}$	$3 \cdot 10^{-10}$	$7 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$8 \cdot 10^{-11}$	$3 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
	Cm 245	S	$5 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$8 \cdot 10^{-11}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
Curium (96)	Cm 246	S	$5 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$8 \cdot 10^{-11}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
	Cm 247	S	$5 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$6 \cdot 10^{-11}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Curium (96)	Cm 248	S	$6 \cdot 10^{-13}$	$1 \cdot 10^{-12}$	$2 \cdot 10^{-11}$	$4 \cdot 10^{-11}$
		I	$1 \cdot 10^{-11}$	$4 \cdot 10^{-12}$	$4 \cdot 10^{-11}$	$1 \cdot 10^{-10}$
	Cm 249	S	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Dysprosium (66)	Dy 165	S	$3 \cdot 10^{-10}$	$1 \cdot 10^{-12}$	$9 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
		I	$2 \cdot 10^{-10}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
	Dy 166	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$8 \cdot 10^{-10}$	$4 \cdot 10^{-12}$
		I	$2 \cdot 10^{-12}$	$1 \cdot 10^{-10}$	$7 \cdot 10^{-10}$	$4 \cdot 10^{-12}$
Einsteinium (99)	Es 253	S	$8 \cdot 10^{-10}$	$7 \cdot 10^{-11}$	$3 \cdot 10^{-11}$	$2 \cdot 10^{-12}$
		I	$6 \cdot 10^{-10}$	$7 \cdot 10^{-11}$	$2 \cdot 10^{-11}$	$2 \cdot 10^{-12}$
	Es 254m	S	$5 \cdot 10^{-10}$	$5 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$2 \cdot 10^{-12}$
		I	$6 \cdot 10^{-10}$	$5 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$2 \cdot 10^{-12}$
Einsteinium (99)	Es 254	S	$2 \cdot 10^{-11}$	$4 \cdot 10^{-11}$	$6 \cdot 10^{-11}$	$1 \cdot 10^{-11}$
		I	$1 \cdot 10^{-10}$	$4 \cdot 10^{-11}$	$4 \cdot 10^{-12}$	$1 \cdot 10^{-11}$
	Es 255	S	$5 \cdot 10^{-10}$	$8 \cdot 10^{-11}$	$2 \cdot 10^{-11}$	$3 \cdot 10^{-12}$
		I	$4 \cdot 10^{-10}$	$8 \cdot 10^{-11}$	$1 \cdot 10^{-11}$	$3 \cdot 10^{-12}$
Erbium (68)	Er 169	S	$6 \cdot 10^{-11}$	$3 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$9 \cdot 10^{-11}$
		I	$4 \cdot 10^{-12}$	$3 \cdot 10^{-11}$	$1 \cdot 10^{-10}$	$9 \cdot 10^{-12}$
	Er 171	S	$7 \cdot 10^{-12}$	$3 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$
		I	$6 \cdot 10^{-12}$	$3 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$
Europium (63)	Eu 152	S	$4 \cdot 10^{-12}$	$2 \cdot 10^{-11}$	$1 \cdot 10^{-10}$	$6 \cdot 10^{-12}$
	(T/2 = 9.2 hrs)	I	$3 \cdot 10^{-12}$	$2 \cdot 10^{-11}$	$1 \cdot 10^{-10}$	$6 \cdot 10^{-12}$
	Eu 152	S	$1 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$8 \cdot 10^{-12}$
	(T/2 = 13 yrs)	I	$2 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$8 \cdot 10^{-12}$
Europium (63)	Eu 154	S	$4 \cdot 10^{-10}$	$6 \cdot 10^{-11}$	$1 \cdot 10^{-10}$	$2 \cdot 10^{-12}$
		I	$7 \cdot 10^{-10}$	$6 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$2 \cdot 10^{-12}$
	Eu 155	S	$9 \cdot 10^{-10}$	$6 \cdot 10^{-11}$	$3 \cdot 10^{-10}$	$2 \cdot 10^{-12}$
		I	$7 \cdot 10^{-10}$	$6 \cdot 10^{-11}$	$3 \cdot 10^{-10}$	$2 \cdot 10^{-12}$
Fermium (100)	Fm 254	S	$6 \cdot 10^{-10}$	$4 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-11}$
		I	$7 \cdot 10^{-10}$	$4 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-11}$
	Fm 255	S	$2 \cdot 10^{-10}$	$1 \cdot 10^{-11}$	$6 \cdot 10^{-11}$	$3 \cdot 10^{-12}$
		I	$1 \cdot 10^{-10}$	$1 \cdot 10^{-11}$	$4 \cdot 10^{-11}$	$3 \cdot 10^{-12}$
Fermium (100)	Fm 256	S	$3 \cdot 10^{-10}$	$3 \cdot 10^{-11}$	$1 \cdot 10^{-10}$	$9 \cdot 10^{-12}$
		I	$2 \cdot 10^{-10}$	$3 \cdot 10^{-11}$	$6 \cdot 10^{-11}$	$9 \cdot 10^{-12}$
	F 18	S	$5 \cdot 10^{-10}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$8 \cdot 10^{-11}$
		I	$3 \cdot 10^{-10}$	$1 \cdot 10^{-12}$	$9 \cdot 10^{-12}$	$5 \cdot 10^{-11}$
Gadolinium (64)	Gd 153	S	$2 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$9 \cdot 10^{-10}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-10}$	$2 \cdot 10^{-12}$
	Gd 159	S	$5 \cdot 10^{-12}$	$2 \cdot 10^{-11}$	$2 \cdot 10^{-10}$	$8 \cdot 10^{-12}$
		I	$4 \cdot 10^{-12}$	$2 \cdot 10^{-11}$	$1 \cdot 10^{-10}$	$8 \cdot 10^{-12}$
Gallium (31)	Ga 72	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$8 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
		I	$2 \cdot 10^{-12}$	$1 \cdot 10^{-11}$	$6 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
Germanium (32)	Ge 71	S	$1 \cdot 10^{-10}$	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$6 \cdot 10^{-10}$	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$

APPENDIX B TO §§ 20.1—20.601—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL
BACKGROUND—Continued

(See footnotes at end of Appendix B)

Element (atomic number)	Isotope ¹		Table I		Table II	
			Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)	Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)
Gold (79).....	Au 196.....	S	$1 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
		I	$6 \cdot 10^{-11}$	$4 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$
	Au 198.....	S	$3 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$5 \cdot 10^{-11}$
		I	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$8 \cdot 10^{-11}$	$5 \cdot 10^{-11}$
	Au 199.....	S	$1 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
Hafnium (72).....		I	$8 \cdot 10^{-11}$	$4 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
	Hf 181.....	S	$4 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$7 \cdot 10^{-11}$
Holmium (67).....		I	$7 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$7 \cdot 10^{-11}$
	Ho 166.....	S	$2 \cdot 10^{-10}$	$9 \cdot 10^{-11}$	$7 \cdot 10^{-11}$	$3 \cdot 10^{-10}$
Hydrogen (1).....		I	$2 \cdot 10^{-11}$	$9 \cdot 10^{-11}$	$6 \cdot 10^{-11}$	$3 \cdot 10^{-10}$
	H3.....	S	$5 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$3 \cdot 10^{-10}$
		I	$5 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$3 \cdot 10^{-10}$
Indium (49).....		Sub	$2 \cdot 10^{-10}$		$4 \cdot 10^{-10}$	
	In 113m.....	S	$8 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$1 \cdot 10^{-10}$
		I	$7 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$
	In 114m.....	S	$1 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
		I	$2 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$7 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
	In 115m.....	S	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$8 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
		I	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
	In 115.....	S	$2 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$9 \cdot 10^{-10}$	$9 \cdot 10^{-10}$
Iodine (53).....		I	$3 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$9 \cdot 10^{-10}$
	I 125.....	S	$5 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$8 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
		I	$2 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
	I 126.....	S	$8 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$9 \cdot 10^{-10}$	$3 \cdot 10^{-10}$
		I	$3 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$9 \cdot 10^{-10}$
	I 129.....	S	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$6 \cdot 10^{-10}$
		I	$7 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
	I 131.....	S	$9 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$3 \cdot 10^{-10}$
		I	$3 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$6 \cdot 10^{-10}$
	I 132.....	S	$2 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$8 \cdot 10^{-10}$
		I	$9 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
	I 133.....	S	$3 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$1 \cdot 10^{-10}$
		I	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$7 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
	I 134.....	S	$5 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
Iridium (77).....		I	$3 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$6 \cdot 10^{-10}$
	I 135.....	S	$1 \cdot 10^{-10}$	$7 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
		I	$4 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$7 \cdot 10^{-10}$
	Ir 190.....	S	$1 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
		I	$4 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
	Ir 192.....	S	$1 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
		I	$3 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$9 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
Iron (26).....	Ir 194.....	S	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$8 \cdot 10^{-10}$	$3 \cdot 10^{-10}$
		I	$2 \cdot 10^{-10}$	$9 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$3 \cdot 10^{-10}$
	Fe 55.....	S	$9 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$8 \cdot 10^{-10}$
Krypton (36).....		I	$1 \cdot 10^{-10}$	$7 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
	Fe 59.....	S	$1 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$6 \cdot 10^{-10}$
		I	$5 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$5 \cdot 10^{-10}$
Lanthanum (57).....	Kr 85m.....	Sub	$6 \cdot 10^{-10}$		$1 \cdot 10^{-10}$	
	Kr 85.....	Sub	$1 \cdot 10^{-10}$		$3 \cdot 10^{-10}$	
	Kr 87.....	Sub	$1 \cdot 10^{-10}$		$2 \cdot 10^{-10}$	
	Kr 88.....	Sub	$1 \cdot 10^{-10}$		$2 \cdot 10^{-10}$	
Lead (82).....	La 140.....	S	$2 \cdot 10^{-10}$	$7 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$7 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
	Pb 203.....	S	$3 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$9 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
Lutetium (71).....		I	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$4 \cdot 10^{-10}$
	Pb 210.....	S	$1 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$1 \cdot 10^{-10}$
		I	$2 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$8 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
	Pb 212.....	S	$2 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$6 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
Manganese (25).....		I	$2 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$7 \cdot 10^{-10}$	$2 \cdot 10^{-10}$
	Lu 177.....	S	$6 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$
Manganese (25).....		I	$5 \cdot 10^{-10}$	$3 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$
	Mn 52.....	S	$2 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$7 \cdot 10^{-10}$	$3 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$9 \cdot 10^{-10}$	$5 \cdot 10^{-10}$	$3 \cdot 10^{-10}$
	Mn 54.....	S	$4 \cdot 10^{-10}$	$4 \cdot 10^{-10}$	$1 \cdot 10^{-10}$	$1 \cdot 10^{-10}$

APPENDIX B TO §§ 20.1—20.601—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL
BACKGROUND—Continued

(See footnotes at end of Appendix B)

Element (atomic number)	Isotope		Table I		Table II	
			Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)	Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)
Mercury (80)	Mn 56	I	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
		S	$8 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
		I	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	Hg 197m	S	$7 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$8 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	Hg 197	S	$1 \cdot 10^{-11}$	$9 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		I	$3 \cdot 10^{-11}$	$1 \cdot 10^{-11}$	$9 \cdot 10^{-12}$	$5 \cdot 10^{-12}$
	Hg 203	S	$7 \cdot 10^{-11}$	$5 \cdot 10^{-11}$	$2 \cdot 10^{-11}$	$2 \cdot 10^{-11}$
Molybdenum (42)		I	$1 \cdot 10^{-11}$	$3 \cdot 10^{-11}$	$4 \cdot 10^{-11}$	$1 \cdot 10^{-11}$
	Mo 99	S	$7 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Neodymium (60)		I	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
	Nd 144	S	$8 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$7 \cdot 10^{-12}$
		I	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$8 \cdot 10^{-12}$
	Nd 147	S	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
Neptunium (93)		I	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
		S	$2 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		I	$1 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
	Np 237	S	$4 \cdot 10^{-12}$	$9 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		I	$1 \cdot 10^{-12}$	$9 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
Nickel (28)		S	$8 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
		I	$7 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	Ni 59	S	$5 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$8 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	Ni 63	S	$6 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
Niobium (Columbium) (41)		I	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$
		S	$9 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
		I	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	Nb 93m	S	$1 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
		I	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$
Osmium (76)		S	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
		I	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	Nb 97	S	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
		I	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
	Os 185	S	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$7 \cdot 10^{-12}$
Osmium (76)		I	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$7 \cdot 10^{-12}$
	Os 191m	S	$2 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		I	$9 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	Os 191	S	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$4 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Palladium (46)		S	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
		I	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$9 \cdot 10^{-12}$	$5 \cdot 10^{-12}$
	Pd 103	S	$1 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		I	$7 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
	Pd 109	S	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
Phosphorus (15)		I	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$
	P 32	S	$7 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Platinum (78)		I	$8 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		S	$8 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
		I	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	Pt 193m	S	$7 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
		I	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	Pt 193	S	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
		I	$3 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	Pt 197m	S	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
Plutonium (94)		I	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$9 \cdot 10^{-12}$
		S	$8 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
		I	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	Pu 238	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$5 \cdot 10^{-12}$
		I	$3 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
	Pu 239	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$5 \cdot 10^{-12}$
		I	$4 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
	Pu 240	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$5 \cdot 10^{-12}$
Plutonium (94)		I	$4 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
	Pu 241	S	$9 \cdot 10^{-12}$	$7 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$

APPENDIX B TO §§ 20.1—20.601—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See footnotes at end of Appendix B)

Element (atomic number)	Isotope ¹		Table I		Table II	
			Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)	Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)
		I	$4 \cdot 10^{-4}$	$4 \cdot 10^{-2}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-1}$
	Pu 242	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-1}$	$6 \cdot 10^{-11}$	$5 \cdot 10^{-4}$
		I	$4 \cdot 10^{-11}$	$9 \cdot 10^{-1}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-1}$
	Pu 243	S	$2 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$6 \cdot 10^{-4}$	$3 \cdot 10^{-1}$
		I	$2 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$8 \cdot 10^{-4}$	$3 \cdot 10^{-1}$
	Pu 244	S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-4}$	$6 \cdot 10^{-11}$	$4 \cdot 10^{-4}$
		I	$3 \cdot 10^{-11}$	$3 \cdot 10^{-4}$	$1 \cdot 10^{-12}$	$1 \cdot 10^{-1}$
Polonium (84)	Po 210	S	$5 \cdot 10^{-10}$	$2 \cdot 10^{-11}$	$2 \cdot 10^{-11}$	$7 \cdot 10^{-1}$
		I	$2 \cdot 10^{-10}$	$8 \cdot 10^{-4}$	$7 \cdot 10^{-12}$	$3 \cdot 10^{-1}$
Potassium (19)	K42	S	$2 \cdot 10^{-10}$	$9 \cdot 10^{-4}$	$7 \cdot 10^{-10}$	$3 \cdot 10^{-1}$
		I	$1 \cdot 10^{-12}$	$6 \cdot 10^{-4}$	$4 \cdot 10^{-10}$	$2 \cdot 10^{-1}$
Praseodymium (59)	Pr 142	S	$2 \cdot 10^{-12}$	$9 \cdot 10^{-4}$	$7 \cdot 10^{-10}$	$3 \cdot 10^{-1}$
		I	$2 \cdot 10^{-12}$	$9 \cdot 10^{-4}$	$5 \cdot 10^{-11}$	$3 \cdot 10^{-1}$
	Pr 143	S	$3 \cdot 10^{-12}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-10}$	$5 \cdot 10^{-1}$
		I	$2 \cdot 10^{-12}$	$1 \cdot 10^{-3}$	$6 \cdot 10^{-11}$	$5 \cdot 10^{-1}$
Promethium (61)	Pm 147	S	$6 \cdot 10^{-10}$	$6 \cdot 10^{-3}$	$2 \cdot 10^{-10}$	$2 \cdot 10^{-1}$
		I	$1 \cdot 10^{-12}$	$6 \cdot 10^{-4}$	$3 \cdot 10^{-10}$	$2 \cdot 10^{-1}$
	Pm 149	S	$3 \cdot 10^{-12}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-10}$	$4 \cdot 10^{-1}$
		I	$2 \cdot 10^{-12}$	$1 \cdot 10^{-3}$	$8 \cdot 10^{-11}$	$4 \cdot 10^{-1}$
Protactinium (91)	Pa 230	S	$2 \cdot 10^{-10}$	$7 \cdot 10^{-4}$	$6 \cdot 10^{-11}$	$2 \cdot 10^{-1}$
		I	$8 \cdot 10^{-10}$	$7 \cdot 10^{-4}$	$3 \cdot 10^{-11}$	$2 \cdot 10^{-1}$
	Pa 231	S	$1 \cdot 10^{-12}$	$3 \cdot 10^{-4}$	$4 \cdot 10^{-11}$	$9 \cdot 10^{-1}$
		I	$1 \cdot 10^{-10}$	$8 \cdot 10^{-4}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-1}$
	Pa 233	S	$6 \cdot 10^{-12}$	$4 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-1}$
		I	$2 \cdot 10^{-12}$	$3 \cdot 10^{-4}$	$6 \cdot 10^{-11}$	$1 \cdot 10^{-1}$
Radium (88)	Ra 223	S	$2 \cdot 10^{-10}$	$2 \cdot 10^{-3}$	$6 \cdot 10^{-11}$	$7 \cdot 10^{-1}$
		I	$2 \cdot 10^{-10}$	$1 \cdot 10^{-1}$	$8 \cdot 10^{-12}$	$4 \cdot 10^{-1}$
	Ra 224	S	$5 \cdot 10^{-10}$	$7 \cdot 10^{-3}$	$2 \cdot 10^{-10}$	$2 \cdot 10^{-1}$
		I	$7 \cdot 10^{-10}$	$2 \cdot 10^{-1}$	$2 \cdot 10^{-11}$	$5 \cdot 10^{-1}$
	Ra 226	S	$3 \cdot 10^{-10}$	$4 \cdot 10^{-3}$	$3 \cdot 10^{-11}$	$3 \cdot 10^{-1}$
		I	$5 \cdot 10^{-10}$	$9 \cdot 10^{-4}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-1}$
	Ra 228	S	$7 \cdot 10^{-11}$	$8 \cdot 10^{-3}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-1}$
		I	$4 \cdot 10^{-11}$	$7 \cdot 10^{-4}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-1}$
Radon (86)	Rn 220	S	$3 \cdot 10^{-1}$		$1 \cdot 10^{-1}$	
	Rn 222	S	$3 \cdot 10^{-4}$		$3 \cdot 10^{-4}$	
Rhenium (75)	Re 183	S	$3 \cdot 10^{-6}$	$2 \cdot 10^{-2}$	$9 \cdot 10^{-6}$	$6 \cdot 10^{-4}$
		I	$2 \cdot 10^{-12}$	$8 \cdot 10^{-4}$	$5 \cdot 10^{-10}$	$3 \cdot 10^{-1}$
	Re 186	S	$6 \cdot 10^{-12}$	$3 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$9 \cdot 10^{-1}$
		I	$2 \cdot 10^{-12}$	$1 \cdot 10^{-4}$	$8 \cdot 10^{-11}$	$5 \cdot 10^{-1}$
	Re 187	S	$9 \cdot 10^{-10}$	$7 \cdot 10^{-3}$	$3 \cdot 10^{-12}$	$3 \cdot 10^{-1}$
		I	$5 \cdot 10^{-12}$	$4 \cdot 10^{-2}$	$2 \cdot 10^{-10}$	$2 \cdot 10^{-1}$
	Re 188	S	$4 \cdot 10^{-12}$	$2 \cdot 10^{-4}$	$1 \cdot 10^{-10}$	$6 \cdot 10^{-1}$
		I	$2 \cdot 10^{-12}$	$9 \cdot 10^{-4}$	$6 \cdot 10^{-11}$	$3 \cdot 10^{-1}$
Rhodium (45)	Rh 103m	S	$8 \cdot 10^{-12}$	$4 \cdot 10^{-4}$	$3 \cdot 10^{-10}$	$1 \cdot 10^{-1}$
		I	$6 \cdot 10^{-12}$	$3 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-1}$
	Rh 105	S	$8 \cdot 10^{-12}$	$4 \cdot 10^{-4}$	$3 \cdot 10^{-10}$	$1 \cdot 10^{-1}$
		I	$5 \cdot 10^{-12}$	$3 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-1}$
Rubidium (37)	Rb 86	S	$3 \cdot 10^{-12}$	$2 \cdot 10^{-4}$	$1 \cdot 10^{-10}$	$7 \cdot 10^{-1}$
		I	$7 \cdot 10^{-12}$	$7 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$2 \cdot 10^{-1}$
	Rb 87	S	$5 \cdot 10^{-12}$	$3 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-1}$
		I	$7 \cdot 10^{-12}$	$5 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$2 \cdot 10^{-1}$
Ruthenium (44)	Ru 97	S	$2 \cdot 10^{-10}$	$1 \cdot 10^{-2}$	$8 \cdot 10^{-11}$	$4 \cdot 10^{-1}$
		I	$2 \cdot 10^{-10}$	$1 \cdot 10^{-2}$	$6 \cdot 10^{-11}$	$3 \cdot 10^{-1}$
	Ru 103	S	$5 \cdot 10^{-12}$	$2 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$8 \cdot 10^{-1}$
		I	$8 \cdot 10^{-12}$	$2 \cdot 10^{-4}$	$3 \cdot 10^{-10}$	$8 \cdot 10^{-1}$
	Ru 105	S	$7 \cdot 10^{-12}$	$3 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-1}$
		I	$5 \cdot 10^{-12}$	$3 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-1}$
	Ru 106	S	$8 \cdot 10^{-12}$	$4 \cdot 10^{-4}$	$3 \cdot 10^{-10}$	$1 \cdot 10^{-1}$
		I	$6 \cdot 10^{-12}$	$3 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$1 \cdot 10^{-1}$
Samarium (62)	Sm 147	S	$7 \cdot 10^{-11}$	$2 \cdot 10^{-4}$	$2 \cdot 10^{-12}$	$6 \cdot 10^{-1}$
		I	$3 \cdot 10^{-10}$	$2 \cdot 10^{-4}$	$9 \cdot 10^{-12}$	$7 \cdot 10^{-1}$
	Sm 151	S	$6 \cdot 10^{-12}$	$1 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$4 \cdot 10^{-1}$
		I	$1 \cdot 10^{-12}$	$1 \cdot 10^{-4}$	$5 \cdot 10^{-11}$	$4 \cdot 10^{-1}$
	Sm 153	S	$5 \cdot 10^{-12}$	$2 \cdot 10^{-4}$	$2 \cdot 10^{-10}$	$8 \cdot 10^{-1}$

APPENDIX B TO §§ 20.1—20.601—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL
BACKGROUND—Continued

(See footnotes at end of Appendix B)

Element (atomic number)	Isotope ¹		Table I		Table II	
			Col. 1—Air ($\mu\text{Ci/ml}$)	Col. 2— Water ($\mu\text{Ci/ml}$)	Col. 1—Air ($\mu\text{Ci/ml}$)	Col. 2— Water ($\mu\text{Ci/ml}$)
Scandium (21)	Sc 46	I	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$8 \cdot 10^{-5}$
		S	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$4 \cdot 10^{-5}$
		I	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$4 \cdot 10^{-5}$
	Sc 47	S	$6 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$9 \cdot 10^{-5}$
		I	$5 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$9 \cdot 10^{-5}$
	Sc 48	S	$2 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$6 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
Selenium (34)	Se 75	I	$1 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$5 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
		S	$1 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$4 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
		I	$1 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$4 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
Silicon (14)	Si 31	S	$6 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$9 \cdot 10^{-5}$
		I	$1 \cdot 10^{-5}$	$6 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$
		I	$6 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$
Silver (47)	Ag 105	S	$6 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$1 \cdot 10^{-5}$
		I	$8 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$1 \cdot 10^{-5}$
	Ag 110m	S	$2 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$7 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
		I	$1 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
	Ag 111	S	$3 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$4 \cdot 10^{-5}$
		I	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$6 \cdot 10^{-5}$	$4 \cdot 10^{-5}$
Sodium (11)	Na 22	S	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$6 \cdot 10^{-5}$	$4 \cdot 10^{-5}$
		I	$9 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
	Na 24	S	$1 \cdot 10^{-5}$	$6 \cdot 10^{-5}$	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$
Strontium (38)	Sr 85m	S	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$7 \cdot 10^{-5}$
		I	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$7 \cdot 10^{-5}$
	Sr 85	S	$2 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$1 \cdot 10^{-5}$
		I	$1 \cdot 10^{-5}$	$5 \cdot 10^{-5}$	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$
	Sr 89	S	$3 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
		I	$4 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
	Sr 90	S	$1 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
		I	$5 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$4 \cdot 10^{-5}$
	Sr 91	S	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$7 \cdot 10^{-5}$
		I	$3 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$5 \cdot 10^{-5}$
	Sr 92	S	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$7 \cdot 10^{-5}$
		I	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$6 \cdot 10^{-5}$
Sulfur (16)	S 35	S	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$6 \cdot 10^{-5}$
		I	$3 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
Tantalum (73)	Ta 182	S	$4 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$4 \cdot 10^{-5}$
		I	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$7 \cdot 10^{-5}$	$4 \cdot 10^{-5}$
Technetium (43)	Tc 96m	S	$8 \cdot 10^{-5}$	$4 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$1 \cdot 10^{-5}$
		I	$3 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$1 \cdot 10^{-5}$
	Tc 96	S	$6 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$
		I	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$5 \cdot 10^{-5}$
	Tc 97m	S	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$4 \cdot 10^{-5}$
		I	$2 \cdot 10^{-5}$	$5 \cdot 10^{-5}$	$5 \cdot 10^{-5}$	$2 \cdot 10^{-5}$
	Tc 97	S	$1 \cdot 10^{-5}$	$5 \cdot 10^{-5}$	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$
		I	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$8 \cdot 10^{-5}$
	Tc 99m	S	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$6 \cdot 10^{-5}$
		I	$1 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$5 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
	Tc 99	S	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$7 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
		I	$6 \cdot 10^{-5}$	$5 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$2 \cdot 10^{-5}$
Tellurium (52)	Te 125m	S	$4 \cdot 10^{-5}$	$5 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$2 \cdot 10^{-5}$
		I	$1 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$4 \cdot 10^{-5}$	$1 \cdot 10^{-5}$
	Te 127m	S	$1 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$5 \cdot 10^{-5}$	$6 \cdot 10^{-5}$
		I	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$5 \cdot 10^{-5}$
	Te 127	S	$2 \cdot 10^{-5}$	$8 \cdot 10^{-5}$	$6 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
		I	$9 \cdot 10^{-5}$	$5 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$
	Te 129m	S	$8 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
		I	$3 \cdot 10^{-5}$	$6 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$2 \cdot 10^{-5}$
	Te 129	S	$5 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$8 \cdot 10^{-5}$
		I	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$8 \cdot 10^{-5}$
	Te 131m	S	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$6 \cdot 10^{-5}$
		I	$2 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$6 \cdot 10^{-5}$	$4 \cdot 10^{-5}$
Terbium (65)	Tb 132	S	$2 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$7 \cdot 10^{-5}$	$3 \cdot 10^{-5}$
		I	$1 \cdot 10^{-5}$	$6 \cdot 10^{-5}$	$4 \cdot 10^{-5}$	$2 \cdot 10^{-5}$
	Tb 160	S	$1 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$3 \cdot 10^{-5}$	$4 \cdot 10^{-5}$

APPENDIX B TO §§ 20.1—20.601—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See footnotes at end of Appendix B)

Element (atomic number)	Isotope ^a		Table I		Table II	
			Col. 1—Air ($\mu\text{Ci}/\text{m}^3$)	Col. 2— Water ($\mu\text{Ci}/\text{m}^3$)	Col. 1—Air ($\mu\text{Ci}/\text{m}^3$)	Col. 2— Water ($\mu\text{Ci}/\text{m}^3$)
Thallium (81)	Tl 200	I	$3 \cdot 10^{-6}$	$1 \cdot 10^{-6}$	$1 \cdot 10^{-6}$	$4 \cdot 10^{-6}$
		S	$3 \cdot 10^{-6}$	$1 \cdot 10^{-6}$	$9 \cdot 10^{-7}$	$4 \cdot 10^{-6}$
		I	$1 \cdot 10^{-6}$	$7 \cdot 10^{-7}$	$4 \cdot 10^{-7}$	$2 \cdot 10^{-6}$
		I	$1 \cdot 10^{-6}$	$7 \cdot 10^{-7}$	$4 \cdot 10^{-7}$	$2 \cdot 10^{-6}$
	Tl 201	S	$2 \cdot 10^{-6}$	$9 \cdot 10^{-7}$	$7 \cdot 10^{-7}$	$3 \cdot 10^{-6}$
		I	$9 \cdot 10^{-7}$	$5 \cdot 10^{-7}$	$3 \cdot 10^{-7}$	$2 \cdot 10^{-6}$
	Tl 202	S	$8 \cdot 10^{-7}$	$4 \cdot 10^{-7}$	$3 \cdot 10^{-7}$	$1 \cdot 10^{-6}$
		I	$2 \cdot 10^{-7}$	$2 \cdot 10^{-7}$	$8 \cdot 10^{-8}$	$7 \cdot 10^{-7}$
Thorium (90)	Tl 204	S	$6 \cdot 10^{-7}$	$3 \cdot 10^{-7}$	$2 \cdot 10^{-7}$	$1 \cdot 10^{-6}$
		I	$3 \cdot 10^{-7}$	$2 \cdot 10^{-7}$	$9 \cdot 10^{-8}$	$6 \cdot 10^{-7}$
	Th 227	S	$3 \cdot 10^{-10}$	$5 \cdot 10^{-11}$	$1 \cdot 10^{-11}$	$2 \cdot 10^{-10}$
		I	$2 \cdot 10^{-10}$	$5 \cdot 10^{-11}$	$6 \cdot 10^{-12}$	$2 \cdot 10^{-10}$
	Th 228	S	$9 \cdot 10^{-12}$	$2 \cdot 10^{-11}$	$3 \cdot 10^{-12}$	$7 \cdot 10^{-11}$
		I	$6 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-10}$
	Th 230	S	$2 \cdot 10^{-12}$	$5 \cdot 10^{-13}$	$8 \cdot 10^{-13}$	$2 \cdot 10^{-11}$
		I	$1 \cdot 10^{-11}$	$9 \cdot 10^{-13}$	$3 \cdot 10^{-12}$	$3 \cdot 10^{-11}$
	Th 231	S	$1 \cdot 10^{-11}$	$7 \cdot 10^{-13}$	$5 \cdot 10^{-13}$	$2 \cdot 10^{-11}$
		I	$1 \cdot 10^{-11}$	$7 \cdot 10^{-13}$	$4 \cdot 10^{-13}$	$2 \cdot 10^{-11}$
	Th 232	S	$3 \cdot 10^{-11}$	$5 \cdot 10^{-13}$	$1 \cdot 10^{-12}$	$2 \cdot 10^{-11}$
		I	$3 \cdot 10^{-11}$	$1 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$4 \cdot 10^{-11}$
Thulium (69)	Th natural	S	$6 \cdot 10^{-11}$	$6 \cdot 10^{-13}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-11}$
		I	$6 \cdot 10^{-11}$	$6 \cdot 10^{-13}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-11}$
	Th 234	S	$6 \cdot 10^{-11}$	$5 \cdot 10^{-13}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-11}$
		I	$3 \cdot 10^{-11}$	$5 \cdot 10^{-13}$	$1 \cdot 10^{-12}$	$2 \cdot 10^{-11}$
	Tm 170	S	$4 \cdot 10^{-11}$	$1 \cdot 10^{-13}$	$1 \cdot 10^{-13}$	$5 \cdot 10^{-12}$
		I	$3 \cdot 10^{-11}$	$1 \cdot 10^{-13}$	$1 \cdot 10^{-13}$	$5 \cdot 10^{-12}$
Tin (50)	Tm 171	S	$1 \cdot 10^{-11}$	$1 \cdot 10^{-13}$	$4 \cdot 10^{-13}$	$5 \cdot 10^{-12}$
		I	$2 \cdot 10^{-11}$	$1 \cdot 10^{-13}$	$8 \cdot 10^{-13}$	$5 \cdot 10^{-12}$
	Sn 113	S	$4 \cdot 10^{-11}$	$2 \cdot 10^{-13}$	$1 \cdot 10^{-13}$	$9 \cdot 10^{-12}$
		I	$5 \cdot 10^{-11}$	$2 \cdot 10^{-13}$	$2 \cdot 10^{-13}$	$8 \cdot 10^{-12}$
Tungsten (Wolfram) (74)	Sn 125	S	$1 \cdot 10^{-11}$	$5 \cdot 10^{-13}$	$4 \cdot 10^{-13}$	$2 \cdot 10^{-12}$
		I	$8 \cdot 10^{-11}$	$5 \cdot 10^{-13}$	$3 \cdot 10^{-13}$	$2 \cdot 10^{-12}$
	W 181	S	$2 \cdot 10^{-11}$	$1 \cdot 10^{-13}$	$8 \cdot 10^{-13}$	$4 \cdot 10^{-12}$
		I	$1 \cdot 10^{-11}$	$1 \cdot 10^{-13}$	$4 \cdot 10^{-13}$	$3 \cdot 10^{-12}$
	W 185	S	$8 \cdot 10^{-12}$	$4 \cdot 10^{-13}$	$3 \cdot 10^{-13}$	$1 \cdot 10^{-11}$
		I	$1 \cdot 10^{-11}$	$3 \cdot 10^{-13}$	$4 \cdot 10^{-13}$	$1 \cdot 10^{-11}$
Uranium (92)	W 187	S	$4 \cdot 10^{-12}$	$2 \cdot 10^{-13}$	$2 \cdot 10^{-13}$	$7 \cdot 10^{-12}$
		I	$3 \cdot 10^{-12}$	$2 \cdot 10^{-13}$	$1 \cdot 10^{-13}$	$6 \cdot 10^{-12}$
	U 230	S	$3 \cdot 10^{-10}$	$1 \cdot 10^{-11}$	$1 \cdot 10^{-12}$	$5 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$1 \cdot 10^{-11}$	$4 \cdot 10^{-12}$	$5 \cdot 10^{-10}$
	U 232	S	$1 \cdot 10^{-10}$	$8 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$3 \cdot 10^{-10}$
		I	$3 \cdot 10^{-11}$	$8 \cdot 10^{-12}$	$9 \cdot 10^{-13}$	$3 \cdot 10^{-10}$
	U 233	S	$5 \cdot 10^{-11}$	$9 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$9 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-10}$
	U 234	S ^b	$6 \cdot 10^{-11}$	$9 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$9 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-10}$
	U 235	S ^b	$5 \cdot 10^{-11}$	$8 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$8 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-10}$
Vanadium (23)	U 236	S	$6 \cdot 10^{-11}$	$1 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$1 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$3 \cdot 10^{-10}$
	U 238	S ^b	$7 \cdot 10^{-11}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$4 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$4 \cdot 10^{-10}$
	U 240	S	$2 \cdot 10^{-11}$	$1 \cdot 10^{-12}$	$8 \cdot 10^{-13}$	$3 \cdot 10^{-10}$
		I	$2 \cdot 10^{-11}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-13}$	$3 \cdot 10^{-10}$
	U-natural	S ^b	$1 \cdot 10^{-10}$	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-10}$
		I	$1 \cdot 10^{-10}$	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-10}$
Xenon (54)	V 48	S	$2 \cdot 10^{-11}$	$9 \cdot 10^{-13}$	$6 \cdot 10^{-13}$	$3 \cdot 10^{-11}$
		I	$6 \cdot 10^{-11}$	$8 \cdot 10^{-13}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-11}$
	Xe 131m	Sub	$2 \cdot 10^{-11}$		$4 \cdot 10^{-12}$	
		Sub	$1 \cdot 10^{-11}$		$3 \cdot 10^{-12}$	
Ytterbium (70)	Xe 133m	Sub	$1 \cdot 10^{-11}$		$3 \cdot 10^{-12}$	
		Sub	$4 \cdot 10^{-11}$		$1 \cdot 10^{-12}$	
	Xe 135	S	$7 \cdot 10^{-12}$	$3 \cdot 10^{-13}$	$2 \cdot 10^{-13}$	$1 \cdot 10^{-11}$
		I	$6 \cdot 10^{-12}$	$3 \cdot 10^{-13}$	$2 \cdot 10^{-13}$	$1 \cdot 10^{-11}$
Yttrium (39)	Y 90	S	$1 \cdot 10^{-11}$	$6 \cdot 10^{-13}$	$4 \cdot 10^{-13}$	$2 \cdot 10^{-11}$

APPENDIX B TO §§ 20.1—20.601—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See footnotes at end of Appendix B)

Element (atomic number)	Isotope ¹		Table I		Table II	
			Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)	Col. 1—Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)
Zinc (30)	Y 91m	I	$1 \cdot 10^{-12}$	$6 \cdot 10^{-14}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		S	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		I	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
	Y 91	S	$4 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		I	$3 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
	Y 92	S	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
		I	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
	Y 93	S	$2 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		I	$1 \cdot 10^{-12}$	$8 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		S	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$1 \cdot 10^{-12}$
	Zn 65	I	$6 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		S	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$7 \cdot 10^{-12}$
Zinc (30)	Zn 69m	I	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
		S	$7 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$9 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	Zn 69	S	$1 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$8 \cdot 10^{-12}$
		I	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$8 \cdot 10^{-12}$
		S	$1 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
	Zr 93	I	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
		S	$1 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
		I	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
	Zr 95	S	$1 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
		I	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$6 \cdot 10^{-12}$
		S	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
Zirconium (40)	Zr 97	I	$9 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		S	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	Sub	S	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		I	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
		S	$1 \cdot 10^{-12}$	$5 \cdot 10^{-12}$	$3 \cdot 10^{-12}$	$2 \cdot 10^{-12}$
	Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours.	S	$3 \cdot 10^{-12}$	$9 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		I	$3 \cdot 10^{-12}$	$9 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		S	$3 \cdot 10^{-12}$	$9 \cdot 10^{-12}$	$1 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
	Any single radionuclide not listed above, which decays by alpha emission or spontaneous fission.	S	$6 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		I	$6 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-12}$
		S	$6 \cdot 10^{-12}$	$4 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$3 \cdot 10^{-12}$

¹Soluble (S); Insoluble (I).²Sub means that values given are for submersion in a semispherical infinite cloud of airborne material.

These radon concentrations are appropriate for protection from radon-222 combined with its short-lived daughters. Alternatively, the value in Table I may be replaced by one-third (1/3) "working level." (A "working level" is defined as any combination of short-lived radon-222 daughters, polonium-218, lead-214, bismuth-214 and polonium-214, in one liter of air, without regard to the degree of equilibrium, that will result in the ultimate emission of $1.3 \cdot 10^{-5}$ MeV of alpha particle energy.) The Table II value may be replaced by one-thirtieth (1/30) of a "working level." The limit on radon-222 concentrations in restricted areas may be based on an annual average.

For soluble mixtures of U-238, U-234 and U-235 in air chemical toxicity may be the limiting factor. If the percent by weight-enrichment of U-235 is less than 5, the concentration value for a 40-hour workweek, Table I, is 0.2 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour workweek shall not exceed $8 \cdot 10^{-1}$ SA $\mu\text{Ci}\cdot\text{hr}/\text{ml}$, where SA is the specific activity of the uranium inhaled. The concentration value for Table II is 0.007 milligrams uranium per cubic meter of air. The specific activity for natural uranium is $6.77 \cdot 10^{-1}$ curies per gram U. The specific activity for other mixtures of U-238, U-235 and U-234, if not known, shall be:

$$\text{SA} = 3.6 \cdot 10^{-1} \text{ curies/gram U} \quad \text{U-depleted} \\ \text{SA} = (0.4 + 0.38 E + 0.0034 E^2) 10^{-1} \quad \text{E} = 0.72$$

where E is the percentage by weight of U-235, expressed as percent.

NOTE: In any case where there is a mixture in air or water of more than one radionuclide, the limiting values for purposes of this Appendix should be determined as follows:

1. If the identity and concentration of each radionuclide in the mixture are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix B for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e., "unity").

EXAMPLE: If radionuclides A, B, and C are present in concentrations C_A , C_B , and C_C , and if the applicable MPC's are MPC_A , and MPC_B , and MPC_C , respectively, then the concentrations shall be limited so that the following relationship exists:

$$(C_A/\text{MPC}_A) + (C_B/\text{MPC}_B) + (C_C/\text{MPC}_C) \leq 1$$

2. If either the identity or the concentration of any radionuclide in the mixture is not known, the limiting values for purposes of Appendix B shall be:

- For purposes of Table I, Col. 1— $6 \cdot 10^{-12}$
- For purposes of Table I, Col. 2— $4 \cdot 10^{-12}$
- For purposes of Table II, Col. 1— $2 \cdot 10^{-12}$
- For purposes of Table II, Col. 2— $3 \cdot 10^{-12}$

3. If any of the conditions specified below are met, the corresponding values specified below may be used in lieu of those specified in paragraph 2 above.

a. If the identity of each radionuclide in the mixture is known but the concentration of one or more of the radionuclides in the mixture is not known the concentration limit for the mixture is the limit specified in Appendix "B" for the radionuclide in the mixture having the lowest concentration limit; or

b. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in Appendix "B" are not present in the mixture, the concentration limit for the mixture is the lowest concentration limit specified in Appendix "B" for any radionuclide which is not known to be absent from the mixture; or

c. Element (atomic number) and isotope	Table I		Table II	
	Col. 1— Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)	Col. 1— Air ($\mu\text{Ci}/\text{ml}$)	Col. 2— Water ($\mu\text{Ci}/\text{ml}$)
If it is known that Sr 90, I 125, I 126, I 129, I 131 (I 133, Table II only), Pb 210, Po 210, At 211, Ra 223, Ra 224, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th-nat, Cm 248, Cf 254, and Fm 256 are not present.		$9 \cdot 10^{-11}$		$3 \cdot 10^{-10}$
If it is known that Sr 90, I 125, I 126, I 129 (I 131, I 133, Table II only), Pb 210, Po 210, Ra 223, Ra 226, Ra 228, Pa 231, Th-nat, Cm 248, Cf 254, and Fm 256 are not present.		$6 \cdot 10^{-12}$		$2 \cdot 10^{-10}$
If it is known that Sr 90, I 125, I 126, I 131, Table II only), Pb 210, Ra 226, Ra 228, Cm 248, and Cf 254 are not present.		$2 \cdot 10^{-12}$		$6 \cdot 10^{-11}$
If it is known that (I 129, Table II only), Ra 226, and Ra 228 are not present.		$3 \cdot 10^{-10}$		$1 \cdot 10^{-11}$
If it is known that alpha-emitters and Sr 90, I 129, Pb 210, Ac 227, Ra 228, Pa 230, Pu 241, and Bk 249 are not present.	$3 \cdot 10^{-10}$		$1 \cdot 10^{-10}$	
If it is known that alpha-emitters and Pb 210, Ac 227, Ra 228, and Pu 241 are not present.	$3 \cdot 10^{-11}$		$1 \cdot 10^{-11}$	
If it is known that alpha-emitters and Ac 227 are not present.	$3 \cdot 10^{-11}$		$1 \cdot 10^{-12}$	
If it is known that Ac 227, Th 230, Pa 231, Pu 238, Pu 239, Pu 240, Pu 242, Pu 244, Cm 248, Cf 249 and Cf 251 are not present.	$3 \cdot 10^{-12}$		$1 \cdot 10^{-13}$	

4. If a mixture of radionuclides consists of uranium and its daughters in ore dust prior to chemical separation of the uranium from the ore, the values specified below may be used for uranium and its daughters through radium-226, instead of those from paragraphs 1, 2, or 3 above.

a. For purposes of Table I, Col. 1— $1 \cdot 10^{-10}$ $\mu\text{Ci}/\text{ml}$ gross alpha activity; or $5 \cdot 10^{-11}$ $\mu\text{Ci}/\text{ml}$ natural uranium or 75 micrograms per cubic meter of air natural uranium.

b. For purposes of Table II, Col. 1— $3 \cdot 10^{-12}$ $\mu\text{Ci}/\text{ml}$ gross alpha activity; $2 \cdot 10^{-12}$ $\mu\text{Ci}/\text{ml}$ natural uranium, or 3 micrograms per cubic meter of air natural uranium.

5. For purposes of this note, a radionuclide may be considered as not present in a mixture if (a) the ratio of the concentration of that radionuclide in the mixture (C_i) to the concentration limit for that radionuclide specified in Table II of Appendix "B" (MPC_i) does not exceed $1/10$, (i.e. $C_i/MPC_i \leq 1/10$) and (b) the sum of such ratios for all the radionuclides considered as not present in the mixture does not exceed $1/4$, i.e.

$$(C_i/MPC_i) + C_j/MPC_j \leq 1/4.$$

(25 FR 10914, Nov. 17, 1960, as amended at 25 FR 13953, Dec. 30, 1960; 26 FR 11046, Nov. 25, 1961; 29 FR 14435, Oct. 21, 1964; 30 FR 15801, Dec. 22, 1965; 31 FR 86, Jan. 5, 1966; 37 FR 23319, Nov. 2, 1972; 38 FR 29314, Oct. 24, 1973; 39 FR 23990, June 28, 1974; 39 FR 25463, July 11, 1974; 39 FR 27121, July 25, 1974; 40 FR 50705, Oct. 31, 1975. Redesignated at 56 FR 23391, May 21, 1991)

APPENDIX C to §§ 20.1—20.601—Continued

APPENDIX C to §§ 20.1—20.601

Material	Microcuries	Material	Microcuries
Americium-241	.01	Calcium-45	10
Antimony-122	100	Calcium-47	10
Antimony-124	10	Carbon-14	100
Antimony-125	10	Cerium-141	100
Arsenic-73	100	Cerium-143	100
Arsenic-74	10	Cerium-144	1
Arsenic-76	10	Cesium-131	1,000
Arsenic-77	100	Cesium-134m	100
Barium-131	10	Cesium-134	1
Barium-133	10	Cesium-135	10
Barium-140	10	Cesium-136	10
Bismuth-210	1	Cesium-137	10
Bromine-82	10	Chlorine-36	10
Cadmium-109	10	Chlorine-38	10
Cadmium-115m	10	Chromium-51	1,000
Cadmium-115	100	Cobalt-58m	10
		Cobalt-58	10

APPENDIX C to §§ 20.1—20.601—Continued

APPENDIX C to §§ 20.1—20.601—Continued

<i>Material</i>	<i>Microcuries</i>	<i>Material</i>	<i>Microcuries</i>
Cobalt-60	1	Praseodymium-142	100
Copper-64	100	Praseodymium-143	100
Dysprosium-165	10	Promethium-147	10
Dysprosium-166	100	Promethium-149	10
Erbium-169	100	Radium-226	.01
Erbium-171	100	Rhenium-186	100
Europium-152 9.2 h	100	Rhenium-188	100
Europium-152 13 y	1	Rhodium-103m	100
Europium-154	1	Rhodium-105	100
Europium-155	10	Rubidium-86	10
Fluorine-18	1,000	Rubidium-87	10
Gadolinium-153	10	Ruthenium-97	100
Gadolinium-159	100	Ruthenium-103	10
Gallium-72	10	Ruthenium-105	10
Germanium-71	100	Ruthenium-106	1
Gold-198	100	Samarium-151	10
Gold-199	100	Samarium-153	100
Hafnium-181	10	Scandium-46	10
Holmium-166	100	Scandium-47	100
Hydrogen-3	1,000	Scandium-48	10
Indium-113m	100	Selenium-75	10
Indium-114m	10	Silicon-31	100
Indium-115m	100	Silver-105	10
Indium-115	10	Silver-110m	1
Iodine-125	1	Silver-111	100
Iodine-126	1	Sodium-24	10
Iodine-129	0.1	Strontium-85	10
Iodine-131	1	Strontium-89	1
Iodine-132	10	Strontium-90	0.1
Iodine-133	1	Strontium-91	10
Iodine-134	10	Strontium-92	10
Iodine-135	10	Sulphur-35	100
Iridium-192	10	Tantalum-182	10
Iridium-194	100	Technetium-96	10
Iron-55	100	Technetium-97m	100
Iron-59	10	Technetium-97	100
Krypton-85	100	Technetium-99m	100
Krypton-87	10	Technetium-99	10
Lanthanum-140	10	Tellurium-125m	10
Luettium-177	100	Tellurium-127m	10
Manganese-52	10	Tellurium-127	100
Manganese-54	10	Tellurium-129m	10
Manganese-56	10	Tellurium-129	100
Mercury-197m	100	Tellurium-131m	10
Mercury-197	100	Tellurium-132	10
Mercury-203	10	Terbium-160	10
Molybdenum-99	100	Thallium-200	100
Neodymium-147	100	Thallium-201	100
Neodymium-149	100	Thallium-202	100
Nickel-59	100	Thallium-204	10
Nickel-63	10	Thorium (natural) ¹	100
Nickel-65	100	Thulium-170	10
Niobium-93m	10	Thulium-171	10
Niobium-95	10	Tin-113	10
Niobium-97	10	Tin-125	10
Osmium-185	10	Tungsten-181	10
Osmium-191m	100	Tungsten-185	10
Osmium-191	100	Tungsten-187	100
Osmium-193	100	Uranium (natural) ²	100
Palladium-103	100	Uranium-233	.01
Palladium-109	100	Uranium-234—Uranium-235	.01
Phosphorus-32	10	Vanadium-48	10
Platinum-191	100	Xenon-131m	1,000
Platinum-193m	100	Xenon-133	100
Platinum-193	100	Xenon-135	100
Platinum-197m	100	Ytterbium-175	100
Platinum-197	100	Yttrium-90	10
Plutonium-239	.01	Yttrium-91	10
Polonium-210	0.1	Yttrium-92	100
Potassium-42	10	Yttrium-93	100

APPENDIX C to §§ 20.1—20.601—Continued

Material	Microcuries
Zinc-65	10
Zinc-69m	100
Zinc-69	1,000
Zirconium-93	10
Zirconium-95	10
Zirconium-97	10
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	.01
Any radionuclide other than alpha emitting radionuclides, not listed above or mixtures of beta emitters of unknown composition	.1

*Based on alpha disintegration rate of Th-232, Th-230 and their daughter products.

*Based on alpha disintegration rate of U-238, U-234, and U-235.

NOTE: For purposes of § 20.303, where there is involved a combination of isotopes in known amounts, the limit for the combination should be derived as follows: Determine, for each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of such ratios for all the isotopes in the combination may not exceed "1" (i.e., "unity").

[35 FR 6425, Apr. 22, 1970, as amended at 36 FR 16898, Aug. 26, 1971; 38 FR 29314, Oct. 24, 1973; 39 FR 23991, June 28, 1974; 45 FR 71763, Oct. 30, 1980. Redesignated at 56 FR 23391, May 21, 1991]

APPENDIX D to §§ 20.1—20.601—UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICES

	Addresses	Telephone (24 hours)
Region I: Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.	USNRC, 475 Allendale Road, King of Prussia, PA 19406.	(215) 337-5000 (FTS) 346-5000
Region II: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, Virginia, Virgin Islands, and West Virginia.	USNRC, 101 Marietta Street, NW, Suite 2900, Atlanta, GA 30323.	(404) 331-4503 (FTS) 242-4503
Region III: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.	USNRC, 799 Roosevelt Road, Glen Ellyn, IL 60137.	(708) 790-5500 (FTS) 388-5500
Region IV: Arkansas, Colorado, Idaho, Kansas, Louisiana, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming.	USNRC, 611 Ryan Plaza Drive, Suite 1000, Arlington, TX 76011.	(817) 860-8100 (FTS) 728-8100
Region IV: Field Office	USNRC, Region IV Uranium Recovery Field Office, 730 Simms Street, P.O. Box 25325, Denver, CO 80225.	(303) 236-2805 (FTS) 776-2805
Region V: Alaska, Arizona, California, Hawaii, Nevada, Oregon, Pacific Trust Territories, and Washington.	USNRC, 1450 Maria Lane, Suite 210, Walnut Creek, CA 94596.	(510) 975-0200

[49 FR 47823, Dec. 7, 1984, as amended at 50 FR 46631, Nov. 12, 1985; 51 FR 35500, Oct. 6, 1986; 53 FR 3862, Feb. 10, 1988; 54 FR 42288, Oct. 16, 1989; 56 FR 19254, Apr. 26, 1991. Redesignated at 56 FR 23391, May 21, 1991; 56 FR 41449, Aug. 21, 1991]

REGULATIONS MANDATORY AS OF JANUARY 1, 1993 WITH EARLIER COMPLIANCE ENCOURAGED

Subpart A—General Provisions

SOURCE: 56 FR 23391, May 21, 1991, unless otherwise noted.

§ 20.1001 Purpose.

(a) The regulations in this part establish standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the Nuclear Regulatory Commission. These regulations are issued under the Atomic Energy

Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended.

(b) It is the purpose of the regulations in this part to control the receipt, possession, use, transfer, and disposal of licensed material by any licensee in such a manner that the total dose to an individual (including doses resulting from licensed and unlicensed radioactive material and from radiation sources other than background radiation) does not exceed the standards for protection against radiation prescribed in the regulations in this part. However, nothing in this part

shall be construed as limiting actions that may be necessary to protect health and safety.

§ 20.1002 Scope.

The regulations in this part apply to persons licensed by the Commission to receive, possess, use, transfer, or dispose of byproduct, source, or special nuclear material or to operate a production or utilization facility under parts 30 through 35, 39, 40, 50, 60, 61, 70, or 72 of this chapter. The limits in this part do not apply to doses due to background radiation, to exposure of patients to radiation for the purpose of medical diagnosis or therapy, or to voluntary participation in medical research programs.

§ 20.1003 Definitions.

As used in this part:

Absorbed dose means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy).

Act means the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended.

Activity is the rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the becquerel (Bq).

Adult means an individual 18 or more years of age.

Airborne radioactive material means radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

Airborne radioactivity area means a room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations—

(1) In excess of the derived air concentrations (DACs) specified in appendix B, to §§ 20.1001-20.2401, or

(2) To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

ALARA (acronym for "as low as is reasonably achievable") means making every reasonable effort to maintain exposures to radiation as far below the

dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

Annual limit on intake (ALI) means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) or a committed dose equivalent of 50 rems (0.5 Sv) to any individual organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in Table 1, Columns 1 and 2, of appendix B to §§ 20.1001-20.2401).

Background radiation means radiation from cosmic sources; naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material) and global fallout as it exists in the environment from the testing of nuclear explosive devices. "Background radiation" does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

Bioassay (radiobioassay) means the determination of kinds, quantities or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct measurement (in vivo counting) or by analysis and evaluation of materials excreted or removed from the human body.

Byproduct material means—

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or utilizing special nuclear material; and

(2) The tailings or wastes produced by the extraction or concentration of

uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition.

Class (or lung class or inhalation class) means a classification scheme for inhaled material according to its rate of clearance from the pulmonary region of the lung. Materials are classified as D, W, or Y, which applies to a range of clearance half-times: for Class D (Days) of less than 10 days, for Class W (Weeks) from 10 to 100 days, and for Class Y (Years) of greater than 100 days.

Collective dose is the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

Commission means the Nuclear Regulatory Commission or its duly authorized representatives.

Committed dose equivalent ($H_{T,50}$) means the dose equivalent in organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed effective dose equivalent ($H_{E,50}$) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($H_{E,50} = \sum w_T H_{T,50}$).

Controlled area means an area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason.

Declared pregnant woman means a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

Deep-dose equivalent (H_d), which applies to external whole-body exposure, is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm²).

Department means the Department of Energy established by the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565, 42 U.S.C. 7101 et seq.) to the extent that the De-

partment, or its duly authorized representatives, exercises functions formerly vested in the U.S. Atomic Energy Commission, its Chairman, members, officers, and components and transferred to the U.S. Energy Research and Development Administration and to the Administrator thereof pursuant to sections 104 (b), (c), and (d) of the Energy Reorganization Act of 1974 (Pub. L. 93-438, 88 Stat. 1233 at 1237, 42 U.S.C. 5814) and retransferred to the Secretary of Energy pursuant to section 301(a) of the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565 at 577-578, 42 U.S.C. 7151).

Derived air concentration (DAC) means the concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI. DAC values are given in Table 1, Column 3, of appendix B to §§ 20.1001-20.2401.

Derived air concentration-hour (DAC-hour) is the product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rems (0.05 Sv).

Dose or radiation dose is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined in other paragraphs of this section.

Dose equivalent (H_T) means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).

Dosimetry processor means an individual or an organization that processes and evaluates individual monitoring equipment in order to determine the radiation dose delivered to the equipment ($H_{E,50} = \sum w_T H_{T,50}$).

Effective dose equivalent (H_E) is the sum of the products of the dose equiv-

alent to the organ or tissue (H_T) and the weighting factors (w_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \sum w_T H_T$).

Embryo/fetus means the developing human organism from conception until the time of birth.

Entrance or access point means any location through which an individual could gain access to radiation areas or to radioactive materials. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

Exposure means being exposed to ionizing radiation or to radioactive material.

External dose means that portion of the dose equivalent received from radiation sources outside the body.

Extremity means hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

Eye dose equivalent applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeter (300 mg/cm²).

Generally applicable environmental radiation standards means standards issued by the Environmental Protection Agency (EPA) under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material.

Government agency means any executive department, commission, independent establishment, corporation wholly or partly owned by the United States of America, which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government.

Gray [See § 20.1004].

High radiation area means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Individual means any human being.

Individual monitoring means—

(1) The assessment of dose equivalent by the use of devices designed to be worn by an individual;

(2) The assessment of committed effective dose equivalent by bioassay (see *Bioassay*) or by determination of the time-weighted air concentrations to which an individual has been exposed, i.e., DAC-hours; or

(3) The assessment of dose equivalent by the use of survey data.

Individual Monitoring Devices (individual monitoring equipment) means devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers, and personal ("lapel") air sampling devices.

Internal dose means that portion of the dose equivalent received from radioactive material taken into the body.

License means a license issued under the regulations in parts 30 through 35, 39, 40, 50, 60, 61, 70, or 72 of this chapter.

Licensed material means source material, special nuclear material, or by-product material received, possessed, used, transferred or disposed of under a general or specific license issued by the Commission.

Licensee means the holder of a license.

Limits (dose limits) means the permissible upper bounds of radiation doses.

Lost or missing licensed material means licensed material whose location is unknown. It includes material that has been shipped but has not reached its destination and whose location cannot be readily traced in the transportation system.

Member of the public means an individual in a controlled or unrestricted area. However, an individual is not a member of the public during any period in which the individual receives an occupational dose.

Minor means an individual less than 18 years of age.

Monitoring (radiation monitoring, radiation protection monitoring) means the measurement of radiation levels, concentrations, surface area

concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

Nonstochastic effect means health effects, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a nonstochastic effect (also called a deterministic effect).

NRC means the Nuclear Regulatory Commission or its duly authorized representatives.

Occupational dose means the dose received by an individual in a restricted area or in the course of employment in which the individual's assigned duties involve exposure to radiation and to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the general public.

Person means—

(1) Any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission or the Department of Energy (except that the Department shall be considered a person within the meaning of the regulations in 10 CFR chapter I to the extent that its facilities and activities are subject to the licensing and related regulatory authority of the Commission under section 202 of the Energy Reorganization Act of 1974 (88 Stat. 1244), the Uranium Mill Tailings Radiation Control Act of 1978 (92 Stat. 3021), the Nuclear Waste Policy Act of 1982 (96 Stat. 2201), and section 3(b)(2) of the Low-Level Radioactive Waste Policy Amendments Act of 1985 (99 Stat. 1842)), any State or any political subdivision of or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and

(2) Any legal successor, representative, agent, or agency of the foregoing.

Planned special exposure means an infrequent exposure to radiation, separate from and in addition to the annual dose limits.

Public dose means the dose received by a member of the public from exposure to radiation and to radioactive material released by a licensee, or to another source of radiation either within a licensee's controlled area or in unrestricted areas. It does not include occupational dose or doses received from background radiation, as a patient from medical practices, or from voluntary participation in medical research programs.

Quality Factor (Q) means the modifying factor (listed in tables 1004(b).1 and 1004(b).2 of § 20.1004) that is used to derive dose equivalent from absorbed dose.

Quarter means a period of time equal to one-fourth of the year observed by the licensee (approximately 13 consecutive weeks), providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

Rad (See § 20.1004).

Radiation (ionizing radiation) means alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in this part, does not include non-ionizing radiation, such as radio- or microwaves, or visible, infrared, or ultraviolet light.

Radiation area means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Reference man means a hypothetical aggregation of human physical and physiological characteristics arrived at by international consensus. These characteristics may be used by researchers and public health workers to standardize results of experiments and to relate biological insult to a common base.

Rem (See § 20.1004).

Respiratory protective device means an apparatus, such as a respirator,

used to reduce the individual's intake of airborne radioactive materials.

Restricted area means an area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

Sanitary sewerage means a system of public sewers for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the licensee.

Shallow-dose equivalent (H_s), which applies to the external exposure of the skin or an extremity, is taken as the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm²) averaged over an area of 1 square centimeter.

Sievert (See § 20.1004).

Site boundary means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee.

Source material means—

(1) Uranium or thorium or any combination of uranium and thorium in any physical or chemical form; or

(2) Ores that contain, by weight, one-twentieth of 1 percent (0.05 percent), or more, of uranium, thorium, or any combination of uranium and thorium. Source material does not include special nuclear material.

Special nuclear material means—

(1) Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the Commission, pursuant to the provisions of section 51 of the Act, determines to be special nuclear material; but does not include source material; or

(2) Any material artificially enriched by any of the foregoing but does not include source material.

Stochastic effects means health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without threshold. Hereditary effects and cancer incidence are examples of stochastic effects.

Survey means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Total Effective Dose Equivalent (TEDE) means the sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Unrestricted area means an area, access to which is neither limited nor controlled by the licensee.

Uranium fuel cycle means the operations of milling of uranium ore, chemical conversion of uranium, isotopic enrichment of uranium, fabrication of uranium fuel, generation of electricity by a light-water-cooled nuclear power plant using uranium fuel, and reprocessing of spent uranium fuel to the extent that these activities directly support the production of electrical power for public use. Uranium fuel cycle does not include mining operations, operations at waste disposal sites, transportation of radioactive material in support of these operations, and the reuse of recovered non-uranium special nuclear and byproduct materials from the cycle.

Very high radiation area means an area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or from any surface that the radiation penetrates.

(NOTE: At very high doses received at high dose rates, units of absorbed dose (e.g., rads and grays) are appropriate, rather than units of dose equivalent (e.g., rems and sieverts)).

Week means 7 consecutive days starting on Sunday.

Weighting factor w_T , for an organ or tissue (T) is the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the

total risk of stochastic effects when the whole body is irradiated uniformly. For calculating the effective dose equivalent, the values of w_T are:

ORGAN DOSE WEIGHTING FACTORS

Organ or tissue	w_T
Gonads	0.25
Breast	0.15
Red bone marrow	0.12
Lung	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder	* 0.30
Whole Body	1.00

* 0.30 results from 0.06 for each of 5 "remainder" organs (excluding the skin and the lens of the eye) that receive the highest doses.

* For the purpose of weighting the external whole body dose (for adding it to the internal dose), a single weighting factor, $w_T = 1.0$, has been specified. The use of other weighting factors for external exposure will be approved on a case-by-case basis until such time as specific guidance is issued.

Whole body means, for purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knee.

Working level (WL) is any combination of short-lived radon daughters (for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212) in 1 liter of air that will result in the ultimate emission of 1.3×10^4 MeV of potential alpha particle energy.

Working level month (WLM) means an exposure to 1 working level for 170 hours (2,000 working hours per year/12 months per year=approximately 170 hours per month).

Year means the period of time beginning in January used to determine compliance with the provisions of this part. The licensee may change the starting date of the year used to determine compliance by the licensee provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

§ 20.1004 Units of radiation dose.

(a) Definitions. As used in this part, the units of radiation dose are:

Gray (Gy) is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 Joule/kilogram (100 rads).

Rad is the special unit of absorbed dose. One rad is equal to an absorbed

dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray).

Rem is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem=0.01 sievert).

Sievert is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv=100 rems).

(b) As used in this part, the quality factors for converting absorbed dose to dose equivalent are shown in table 1004(b).1.

TABLE 1004(b).1—QUALITY FACTORS AND ABSORBED DOSE EQUIVALENCIES

Type of radiation	Quality factor	Absorbed dose equal to a unit dose equivalent *
	(Q)	
X-, gamma, or beta radiation	1	1
Alpha particles, multiple-charged particles, fission fragments and heavy particles of unknown charge	20	0.05
Neutrons of unknown energy	10	0.1
High-energy protons	10	0.1

* Absorbed dose in rad equal to 1 rem or the absorbed dose in gray equal to 1 sievert.

(c) If it is more convenient to measure the neutron fluence rate than to determine the neutron dose equivalent rate in rems per hour or sieverts per hour, as provided in paragraph (b) of this section, 1 rem (0.01 Sv) of neutron radiation of unknown energies may, for purposes of the regulations in this part, be assumed to result from a total fluence of 25 million neutrons per square centimeter incident upon the body. If sufficient information exists to estimate the approximate energy distribution of the neutrons, the licensee may use the fluence rate per unit dose equivalent or the appropriate Q value from table 1004(b).2 to convert a measured tissue dose in rads to dose equivalent in rems.

TABLE 1004(b).2—MEAN QUALITY FACTORS, Q,
AND FLUENCE PER UNIT DOSE EQUIVALENT
FOR MONOENERGETIC NEUTRONS

	Neutron energy (MeV)	Quality factor * (Q)	Fluence per unit dose equivalent * (neutrons cm ⁻² rem ⁻¹)
(thermal)	2.5 · 10 ⁻¹¹	2	980 · 10 ⁻⁶
	1 · 10 ⁻¹⁰	2	980 · 10 ⁻⁶
	1 · 10 ⁻¹⁰	2	810 · 10 ⁻⁶
	1 · 10 ⁻¹⁰	2	810 · 10 ⁻⁶
	1 · 10 ⁻¹⁰	2	840 · 10 ⁻⁶
	1 · 10 ⁻¹⁰	2	980 · 10 ⁻⁶
	1 · 10 ⁻¹⁰	2.5	1010 · 10 ⁻⁶
	1 · 10 ⁻¹⁰	7.5	170 · 10 ⁻⁶
	5 · 10 ⁻¹¹	11	39 · 10 ⁻⁶
	1	11	27 · 10 ⁻⁶
	2.5	9	29 · 10 ⁻⁶
	5	8	23 · 10 ⁻⁶
	7	7	24 · 10 ⁻⁶
	10	6.5	24 · 10 ⁻⁶
	14	7.5	17 · 10 ⁻⁶
	20	8	16 · 10 ⁻⁶
	40	7	14 · 10 ⁻⁶
	60	5.5	16 · 10 ⁻⁶
	1 · 10 ⁻⁷	4	20 · 10 ⁻⁶
	2 · 10 ⁻⁷	3.5	19 · 10 ⁻⁶
	3 · 10 ⁻⁷	3.5	16 · 10 ⁻⁶
	4 · 10 ⁻⁷	3.5	14 · 10 ⁻⁶

* Value of quality factor (Q) at the point where the dose equivalent is maximum in a 30-cm diameter cylinder tissue-equivalent phantom.

* Monoenergetic neutrons incident normally on a 30-cm diameter cylinder tissue-equivalent phantom.

§ 20.1005 Units of radioactivity.

For the purposes of this part, activity is expressed in the special unit of curies (Ci) or in the SI unit of becquerels (Bq), or their multiples, or disintegrations (transformations) per unit of time.

(a) One becquerel=1 disintegration per second (s⁻¹).

(b) One curie=3.7×10¹⁰ disintegrations per second=3.7×10¹⁰ becquerels=2.22×10¹² disintegrations per minute.

[56 FR 23391, May 21, 1991; 56 FR 61352, Dec. 3, 1991]

§ 20.1006 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by an officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

§ 20.1007 Communications.

Unless otherwise specified, communications or reports concerning the regulations in this part should be addressed to the Executive Director for Operations, U.S. Nuclear Regulatory Commission, Washington, DC 20555. A communication, report, or application may be delivered in person to the Office of the Executive Director for Operations, 11555 Rockville Pike, Rockville, MD 20852.

§ 20.1008 Implementation.

(a) Licensees shall implement the provisions of §§ 20.1001-20.2401 on or before January 1, 1993. If a licensee chooses to implement the provisions of §§ 20.1001-20.2401 prior to January 1, 1993, the licensee shall implement all provisions of these sections not otherwise exempted by paragraph (d) of this section, and shall provide written notification to either the Director of the Office of Nuclear Materials Safety and Safeguards or the Director of the Office of Nuclear Reactor Regulation, as appropriate, that the licensee is adopting early implementation of §§ 20.1001-20.2401 and associated appendices. Until January 1, 1993, or until the licensee notifies the Commission of early implementation, compliance will be required with §§ 20.1-20.601 of this part.

(b) After the time the licensee implements §§ 20.1001-20.2401, the applicable section of §§ 20.1001-20.2401 shall be used in lieu of any section in §§ 20.1-20.601 of this part that is cited in license conditions or technical specifications, except as specified in paragraphs (c), (d) and (e) of this section. If the requirements of this part are more restrictive than the existing license condition, then the licensee shall comply with this part unless exempted by paragraph (d) of this section.

(c) Any existing license condition or technical specification that is more restrictive than a requirement in §§ 20.1001-20.2401 remains in force until there is a technical specification change, license amendment, or license renewal.

(d) If a license condition or technical specification exempted a licensee from

a provision of Part 20 in §§ 20.1-20.601, it exempts a licensee from the corresponding provision of §§ 20.1091-20.2401.

(e) If a license condition cites provisions in §§ 20.1-20.601 and there are no corresponding provisions in §§ 20.1001-20.2401, then the license condition remains in force until there is a technical specification change, license amendment, or license renewal that modifies or removes this condition.

§ 20.1009 Reporting, recording, and application requirements: OMB approval.

(a) The Nuclear Regulatory Commission will submit the information collection requirements contained in this part to the Office of Management and Budget for approval as required by the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.). The information collection requirements in this part will not become effective until OMB clearance is obtained and published in the *FEDERAL REGISTER*.

(b) The information collection requirements contained in this part appear in §§ 20.1101, 20.1202, 20.1204, 20.1206, 20.1301, 20.1501, 20.1601, 20.1603, 20.1703, 20.1901, 20.1902, 20.1904, 20.1906, 20.2002, 20.2004, 20.2006, 20.2102, 20.2103, 20.2104, 20.2105, 20.2106, 20.2107, 20.2108, 20.2109, 20.2110, 20.2201, 20.2202, 20.2203, 20.2204, 20.2206, Appendix F to §§ 20.1001-20.2401, and NRC Form 1 and NRC Form 5.

Subpart B—Radiation Protection Programs

SOURCE: 56 FR 23396, May 21, 1991, unless otherwise noted.

§ 20.1101 Radiation protection programs.

(a) Each licensee shall develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with the provisions of this part. See § 20.2102 for recordkeeping requirements relating to these programs.

(b) The licensee shall use, to the extent practicable, procedures and engineering controls based upon sound

radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

(c) The licensee shall periodically (at least annually) review the radiation protection program content and implementation.

Subpart C—Occupational Dose Limits

SOURCE: 56 FR 23396, May 21, 1991, unless otherwise noted.

§ 20.1201 Occupational dose limits for adults.

(a) The licensee shall control the occupational dose to individual adults, except for planned special exposures under § 20.1206, to the following dose limits.

(1) An annual limit, which is the more limiting of—

(i) The total effective dose equivalent being equal to 5 rems (0.05 Sv); or

(ii) The sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.5 Sv).

(2) The annual limits to the lens of the eye, to the skin, and to the extremities, which are:

(i) An eye dose equivalent of 15 rems (0.15 Sv), and

(ii) A shallow-dose equivalent of 50 rems (0.50 Sv) to the skin or to any extremity.

(b) Doses received in excess of the annual limits, including doses received during accidents, emergencies, and planned special exposures, must be subtracted from the limits for planned special exposures that the individual may receive during the current year (see § 20.1206(e)(1)) and during the individual's lifetime (see § 20.1206(e)(2)).

(c) The assigned deep-dose equivalent and shallow-dose equivalent must be for the part of the body receiving the highest exposure. The deep-dose equivalent, eye dose equivalent and shallow-dose equivalent may be assessed from surveys or other radiation measurements for the purpose of demonstrating compliance with the occupational dose limits, if the individual monitoring device was not in the

region of highest potential exposure, or the results of individual monitoring are unavailable.

(d) Derived air concentration (DAC) and annual limit on intake (ALI) values are presented in table 1 of appendix B to §§ 20.1001-20.2401 and may be used to determine the individual's dose (see § 20.2106) and to demonstrate compliance with the occupational dose limits.

(e) In addition to the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity (see footnote 3 of appendix B to §§ 20.1001-20.2401).

(f) The licensee shall reduce the dose that an individual may be allowed to receive in the current year by the amount of occupational dose received while employed by any other person (see § 20.2104(e)).

§ 20.1202 Compliance with requirements for summation of external and internal doses.

(a) If the licensee is required to monitor under both §§ 20.1502(a) and (b), the licensee shall demonstrate compliance with the dose limits by summing external and internal doses. If the licensee is required to monitor only under § 20.1502(a) or only under § 20.1502(b), then summation is not required to demonstrate compliance with the dose limits. The licensee may demonstrate compliance with the requirements for summation of external and internal doses by meeting one of the conditions specified in paragraph (b) of this section and the conditions in paragraphs (c) and (d) of this section.

(NOTE: The dose equivalents for the lens of the eye, the skin, and the extremities are not included in the summation, but are subject to separate limits.)

(b) *Intake by inhalation.* If the only intake of radionuclides is by inhalation, the total effective dose equivalent limit is not exceeded if the sum of the deep-dose equivalent divided by the total effective dose equivalent limit, and one of the following, does not exceed unity:

(1) The sum of the fractions of the inhalation ALI for each radionuclide, or

(2) The total number of derived air concentration-hours (DAC-hours) for all radionuclides divided by 2,000, or

(3) The sum of the calculated committed effective dose equivalents to all significantly irradiated¹ organs or tissues (T) calculated from bioassay data using appropriate biological models and expressed as a fraction of the annual limit.

(c) *Intake by oral ingestion.* If the occupationally exposed individual also receives an intake of radionuclides by oral ingestion greater than 10 percent of the applicable oral ALI, the licensee shall account for this intake and include it in demonstrating compliance with the limits.

(d) *Intake through wounds or absorption through skin.* The licensee shall evaluate and, to the extent practical, account for intakes through wounds or skin absorption.

NOTE: The intake through intact skin has been included in the calculation of DAC for hydrogen-3 and does not need to be further evaluated.

§ 20.1203 Determination of external dose from airborne radioactive material.

Licensees shall, when determining the dose from airborne radioactive material, include the contribution to the deep-dose equivalent, eye dose equivalent, and shallow-dose equivalent from external exposure to the radioactive cloud (see appendix B to §§ 20.1001-20.2401, footnotes 1 and 2).

NOTE: Airborne radioactivity measurements and DAC values should not be used as the primary means to assess the deep-dose equivalent when the airborne radioactive material includes radionuclides other than noble gases or if the cloud of airborne radioactive material is not relatively uniform. The determination of the deep-dose equivalent to an individual should be based

¹ An organ or tissue is deemed to be significantly irradiated if, for that organ or tissue, the product of the weighting factors, w_T , and the committed dose equivalent, H_{50} , per unit intake is greater than 10 percent of the maximum weighted value of H_{50} (i.e., $w_T H_{50,T}$) per unit intake for any organ or tissue.

upon measurements using instruments or individual monitoring devices.

§ 20.1204 Determination of internal exposure.

(a) For purposes of assessing dose used to determine compliance with occupational dose equivalent limits, the licensee shall, when required under § 20.1502, take suitable and timely measurements of—

- (1) Concentrations of radioactive materials in air in work areas; or
- (2) Quantities of radionuclides in the body; or
- (3) Quantities of radionuclides excreted from the body; or
- (4) Combinations of these measurements.

(b) Unless respiratory protective equipment is used, as provided in § 20.1703, or the assessment of intake is based on bioassays, the licensee shall assume that an individual inhales radioactive material at the airborne concentration in which the individual is present.

(c) When specific information on the physical and biochemical properties of the radionuclides taken into the body or the behavior of the material in an individual is known, the licensee may—

(1) Use that information to calculate the committed effective dose equivalent, and, if used, the licensee shall document that information in the individual's record; and

(2) Upon prior approval of the Commission, adjust the DAC or ALI values to reflect the actual physical and chemical characteristics of airborne radioactive material (e.g., aerosol size distribution or density); and

(3) Separately assess the contribution of fractional intakes of Class D, W, or Y compounds of a given radionuclide (see appendix B to §§ 20.1001-20.2401) to the committed effective dose equivalent.

(d) If the licensee chooses to assess intakes of Class Y material using the measurements given in § 20.1204(a)(2) or (3), the licensee may delay the recording and reporting of the assessments for periods up to 7 months, unless otherwise required by §§ 20.2202 or 20.2203, in order to permit the licensee to make additional

measurements basic to the assessments.

(e) If the identity and concentration of each radionuclide in a mixture are known, the fraction of the DAC applicable to the mixture for use in calculating DAC-hours must be either—

(1) The sum of the ratios of the concentration to the appropriate DAC value (e.g., D, W, Y) from appendix B to §§ 20.1001-20.2401 for each radionuclide in the mixture; or

(2) The ratio of the total concentration for all radionuclides in the mixture to the most restrictive DAC value for any radionuclide in the mixture.

(f) If the identity of each radionuclide in a mixture is known, but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture must be the most restrictive DAC of any radionuclide in the mixture.

(g) When a mixture of radionuclides in air exists, licensees may disregard certain radionuclides in the mixture if—

(1) The licensee uses the total activity of the mixture in demonstrating compliance with the dose limits in § 20.1201 and in complying with the monitoring requirements in § 20.1502(b), and

(2) The concentration of any radionuclide disregarded is less than 10 percent of its DAC, and

(3) The sum of these percentages for all of the radionuclides disregarded in the mixture does not exceed 30 percent.

(h)(1) In order to calculate the committed effective dose equivalent, the licensee may assume that the inhalation of one ALI, or an exposure of 2,000 DAC-hours, results in a committed effective dose equivalent of 5 rem (0.05 Sv) for radionuclides that have their ALIs or DACs based on the committed effective dose equivalent.

(2) When the ALI (and the associated DAC) is determined by the nonstochastic organ dose limit of 50 rems (0.5 Sv), the intake of radionuclides that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) (the stochastic ALI) is listed in parentheses in table 1 of appendix B §§ 20.1001-20.2401. In this case, the licensee may, as a simplifying assumption,

tion, use the stochastic ALIs to determine committed effective dose equivalent. However, if the licensee uses the stochastic ALIs, the licensee must also demonstrate that the limit in § 20.1201(a)(1)(ii) is met.

§ 20.1205 [Reserved]

§ 20.1206 Planned special exposures.

A licensee may authorize an adult worker to receive doses in addition to and accounted for separately from the doses received under the limits specified in § 20.1201 provided that each of the following conditions is satisfied—

(a) The licensee authorizes a planned special exposure only in an exceptional situation when alternatives that might avoid the higher exposure are unavailable or impractical.

(b) The licensee (and employer if the employer is not the licensee) specifically authorizes the planned special exposure, in writing, before the exposure occurs.

(c) Before a planned special exposure, the licensee ensures that the individuals involved are—

(1) Informed of the purpose of the planned operation;

(2) Informed of the estimated doses and associated potential risks and specific radiation levels or other conditions that might be involved in performing the task; and

(3) Instructed in the measures to be taken to keep the dose ALARA considering other risks that may be present.

(d) Prior to permitting an individual to participate in a planned special exposure, the licensee ascertains prior doses as required by § 20.2104(b) during the lifetime of the individual for each individual involved.

(e) Subject to § 20.1201(b), the licensee does not authorize a planned special exposure that would cause an individual to receive a dose from all planned special exposures and all doses in excess of the limits to exceed—

(1) The numerical values of any of the dose limits in § 20.1201(a) in any year; and

(2) Five times the annual dose limits in § 20.1201(a) during the individual's lifetime.

(f) The licensee maintains records of the conduct of a planned special exposure in accordance with § 20.2105 and submits a written report in accordance with § 20.2204.

(g) The licensee records the best estimate of the dose resulting from the planned special exposure in the individual's record and informs the individual, in writing, of the dose within 30 days from the date of the planned special exposure. The dose from planned special exposures is not to be considered in controlling future occupational dose of the individual under § 20.1201(a) but is to be included in evaluations required by § 20.1206 (d) and (e).

§ 20.1207 Occupational dose limits for minors.

The annual occupational dose limits for minors are 10 percent of the annual dose limits specified for adult workers in § 20.1201.

§ 20.1208 Dose to an embryo/fetus.

(a) The licensee shall ensure that the dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv). (For recordkeeping requirements, see § 20.2106.)

(b) The licensee shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in paragraph (a) of this section.

(c) The dose to an embryo/fetus shall be taken as the sum of—

(1) The deep-dose equivalent to the declared pregnant woman; and

(2) The dose to the embryo/fetus from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

(d) If the dose to the embryo/fetus is found to have exceeded 0.5 rem (5 mSv), or is within 0.05 rem (0.5 mSv) of this dose, by the time the woman declares the pregnancy to the licensee, the licensee shall be deemed to be in compliance with paragraph (a) of this section if the additional dose to the embryo/fetus does not exceed 0.05

rem (0.5 mSv) during the remainder of the pregnancy.

Subpart D—Radiation Dose Limits for Individual Members of the Public

SOURCE: 56 FR 23398, May 21, 1991, unless otherwise noted.

§ 20.1301 Dose limits for individual members of the public.

(a) Each licensee shall conduct operations so that—

(1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year, exclusive of the dose contribution from the licensee's disposal of radioactive material into sanitary sewerage in accordance with § 20.2003, and

(2) The dose in any unrestricted area from external sources does not exceed 0.002 rem (0.02 mSv) in any one hour.

(b) If the licensee permits members of the public to have access to controlled areas, the limits for members of the public continue to apply to those individuals.

(c) A licensee or license applicant may apply for prior NRC authorization to operate up to an annual dose limit for an individual member of the public of 0.5 rem (5 mSv). The licensee or license applicant shall include the following information in this application:

(1) Demonstration of the need for and the expected duration of operations in excess of the limit in paragraph (a) of this section;

(2) The licensee's program to assess and control dose within the 0.5 rem (5 mSv) annual limit; and

(3) The procedures to be followed to maintain the dose as low as is reasonably achievable.

(d) In addition to the requirements of this part, a licensee subject to the provisions of EPA's generally applicable environmental radiation standards in 40 CFR Part 190 shall comply with those standards.

(e) The Commission may impose additional restrictions on radiation levels in unrestricted areas and on the total quantity of radionuclides that a licensee may release in effluents in order to restrict the collective dose.

§ 20.1302 Compliance with dose limits for individual members of the public.

(a) The licensee shall make or cause to be made, as appropriate, surveys of radiation levels in unrestricted and controlled areas and radioactive materials in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits for individual members of the public in § 20.1301.

(b) A licensee shall show compliance with the annual dose limit in § 20.1301 by—

(1) Demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit; or

(2) Demonstrating that—

(i) The annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in table 2 of appendix B to §§ 20.1001-20.2401; and

(ii) If an individual were continually present in an unrestricted area, the dose from external sources would not exceed 0.002 rem (0.02 mSv) in an hour and 0.05 rem (0.5 mSv) in a year.

(c) Upon approval from the Commission, the licensee may adjust the effluent concentration values in appendix B to §§ 20.1001-20.2401, table 2, for members of the public, to take into account the actual physical and chemical characteristics of the effluents (e.g., aerosol size distribution, solubility, density, radioactive decay equilibrium, chemical form).

[56 FR 23398, May 21, 1991; 56 FR 61352, Dec. 3, 1991]

Subpart E—[Reserved]

Subpart F—Surveys and Monitoring

SOURCE: 56 FR 23398, May 21, 1991, unless otherwise noted.

§ 20.1501 General.

(a) Each licensee shall make or cause to be made, surveys that—

(1) May be necessary for the licensee to comply with the regulations in this part; and

(2) Are reasonable under the circumstances to evaluate—

(i) The extent of radiation levels; and

(ii) Concentrations or quantities of radioactive material; and

(iii) The potential radiological hazards that could be present.

(b) The licensee shall ensure that instruments and equipment used for quantitative radiation measurements (e.g., dose rate and effluent monitoring) are calibrated periodically for the radiation measured.

(c) All personnel dosimeters (except for direct and indirect reading pocket ionization chambers and those dosimeters used to measure the dose to the extremities) that require processing to determine the radiation dose and that are used by licensees to comply with § 20.1201, with other applicable provisions of this chapter, or with conditions specified in a license must be processed and evaluated by a dosimetry processor—

(1) Holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology; and

(2) Approved in this accreditation process for the type of radiation or radiations included in the NVLAP program that most closely approximates the type of radiation or radiations for which the individual wearing the dosimeter is monitored.

§ 20.1502 Conditions requiring individual monitoring of external and internal occupational dose.

Each licensee shall monitor exposures to radiation and radioactive material at levels sufficient to demonstrate compliance with the occupational dose limits of this part. As a minimum—

(a) Each licensee shall monitor occupational exposure to radiation and shall supply and require the use of individual monitoring devices by—

(1) Adults likely to receive, in 1 year from sources external to the body, a

dose in excess of 10 percent of the limits in § 20.1201(a),

(2) Minors and declared pregnant women likely to receive, in 1 year from sources external to the body, a dose in excess of 10 percent of any of the applicable limits in § 20.1207 or § 20.1208, and

(3) Individuals entering a high or very high radiation area.

(b) Each licensee shall monitor (see § 20.1204) the occupational intake of radioactive material by and assess the committed effective dose equivalent to—

(1) Adults likely to receive, in 1 year, an intake in excess of 10 percent of the applicable ALI(s) in table 1, Columns 1 and 2, of appendix B to §§ 20.1001-20.2401; and

(2) Minors and declared pregnant women likely to receive, in 1 year, a committed effective dose equivalent in excess of 0.05 rem (0.5 mSv).

Subpart G—Control of Exposure From External Sources in Restricted Areas

SOURCE: 56 FR 23398, May 21, 1991, unless otherwise noted.

§ 20.1601 Control of access to high radiation areas.

(a) The licensee shall ensure that each entrance or access point to a high radiation area has one or more of the following features—

(1) A control device that, upon entry into the area, causes the level of radiation to be reduced below that level at which an individual might receive a deep-dose equivalent of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates;

(2) A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry; or

(3) Entryways that are locked, except during periods when access to the areas is required, with positive control over each individual entry.

(b) In place of the controls required by paragraph (a) of this section for a

high radiation area, the licensee may substitute continuous direct or electronic surveillance that is capable of preventing unauthorized entry.

(c) A licensee may apply to the Commission for approval of alternative methods for controlling access to high radiation areas.

(d) The licensee shall establish the controls required by paragraphs (a) and (c) of this section in a way that does not prevent individuals from leaving a high radiation area.

(e) Control is not required for each entrance or access point to a room or other area that is a high radiation area solely because of the presence of radioactive materials prepared for transport and packaged and labeled in accordance with the regulations of the Department of Transportation provided that—

(1) The packages do not remain in the area longer than 3 days; and

(2) The dose rate at 1 meter from the external surface of any package does not exceed 0.01 rem (0.1 mSv) per hour.

(f) Control of entrance or access to rooms or other areas in hospitals is not required solely because of the presence of patients containing radioactive material, provided that there are personnel in attendance who will take the necessary precautions to prevent the exposure of individuals to radiation or radioactive material in excess of the limits established in this part and to operate within the ALARA provisions of the licensee's radiation protection program.

§ 20.1602 Control of access to very high radiation areas.

In addition to the requirements in § 20.1601, the licensee shall institute additional measures to ensure that an individual is not able to gain unauthorized or inadvertent access to areas in which radiation levels could be encountered at 500 rads (5 grays) or more in 1 hour at 1 meter from a radiation source or any surface through which the radiation penetrates.

§ 20.1603 Control of access to very high radiation areas—irradiators.

(a) Each area in which there may exist radiation levels in excess of 500

rads (5 grays) in 1 hour at 1 meter from a sealed radioactive source² that is used to irradiate materials must meet the following requirements.

(1) Each entrance or access point must be equipped with entry control devices which—

(i) Function automatically to prevent any individual from inadvertently entering the area when very high radiation levels exist;

(ii) Permit deliberate entry into the area only after a control device is actuated that causes the radiation level within the area, from the sealed source, to be reduced below that at which it would be possible for an individual to receive a deep-dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour; and

(iii) Prevent operation of the source if the source would produce radiation levels in the area that could result in a deep-dose equivalent to an individual in excess of 0.1 rem (1 mSv) in 1 hour.

(2) Additional control devices must be provided so that, upon failure of the entry control devices to function as required by paragraph (a)(1) of this section—

(i) The radiation level within the area, from the sealed source, is reduced below that at which it would be possible for an individual to receive a deep-dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour; and

(ii) Conspicuous visible and audible alarm signals are generated to make an individual attempting to enter the area aware of the hazard and at least one other authorized individual, who is physically present, familiar with the

² This section applies to radiation from byproduct, source, or special nuclear materials that are used in sealed sources in non-self-shielded irradiators. This section does not apply to radioactive sources that are used in teletherapy, in radiography, or in completely self-shielded irradiators in which the source is both stored and operated within the same shielding radiation barrier and, in the designed configuration of the irradiator, is always physically inaccessible to any individual and cannot create high levels of radiation in an area that is accessible to any individual. This section also does not apply to sources from which the radiation is incidental to some other use or to nuclear reactor-generated radiation.

activity, and prepared to render or summon assistance, aware of the failure of the entry control devices.

~~(3) The licensee shall provide control devices so that, upon failure or removal of physical radiation barriers other than the source's shielded storage container—~~

(i) The radiation level from the source is reduced below that at which it would be possible for an individual to receive a deep-dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour; and

(ii) Conspicuous visible and audible alarm signals are generated to make potentially affected individuals aware of the hazard and the licensee or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of the failure or removal of the physical barrier.

(4) ~~When the shield for the stored source is a liquid, the licensee shall provide means to monitor the integrity of the shield and to signal, automatically, loss of adequate shielding.~~

(5) Physical radiation barriers that comprise permanent structural components, such as walls, that have no credible probability of failure or removal in ordinary circumstances need not meet the requirements of paragraphs (a) (3) and (4) of this section.

(6) Each area must be equipped with devices that will automatically generate conspicuous visible and audible alarm signals to alert personnel in the area before the source can be put into operation and in sufficient time for any individual in the area to operate a clearly identified control device, which must be installed in the area and which can prevent the source from being put into operation.

(7) Each area must be controlled by use of such administrative procedures and such devices as are necessary to ensure that the area is cleared of personnel prior to each use of the source.

(8) Each area must be checked by a radiation measurement to ensure that, prior to the first individual's entry into the area after any use of the source, the radiation level from the source in the area is below that at which it would be possible for an individual to receive a deep-dose equivalent

in excess of 0.1 rem (1 mSv) in 1 hour.

(9) The entry control devices required in paragraph (a)(1) of this section must have been tested for proper functioning (see § 20.2109 for record-keeping requirements).

(i) Testing must be conducted prior to initial operation with the source of radiation on any day (unless operations were continued uninterrupted from the previous day); and

(ii) Testing must be conducted prior to resumption of operation of the source of radiation after any unintended interruption; and

(iii) The licensee shall submit and adhere to a schedule for periodic tests of the entry control and warning systems.

(10) The licensee may not conduct operations, other than those necessary to place the source in safe condition or to effect repairs on controls, unless control devices are functioning properly.

(11) Entry and exit portals that are used in transporting materials to and from the irradiation area, and that are not intended for use by individuals, must be controlled by such devices and administrative procedures as are necessary to physically protect and warn against inadvertent entry by any individual through these portals. Exit portals for processed materials must be equipped to detect and signal the presence of any loose radiation sources that are carried toward such an exit and to automatically prevent loose radiation sources from being carried out of the area.

(b) Persons holding licenses or applicants for licenses for radiation sources that are within the purview of paragraph (a) of this section and that will be used in a variety of positions or in locations, such as open fields or forests, that make it impracticable to comply with certain requirements of paragraph (a) of this section, such as those for the automatic control of radiation levels, may apply to the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555, for approval of the use of alternative safety measures. Any alternative safety measures must provide a

degree of personnel protection at least equivalent to those specified in paragraph (a) of this section. At least one of the alternative measures must include an entry-preventing interlock control based on a measurement of the radiation that ensures the absence of high radiation levels before an individual can gain access to the area where such radiation sources are used.

(c) The entry control devices required by paragraphs (a) and (b) of this section must be established in such a way that no individual will be prevented from leaving the area.

Subpart H—Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas

SOURCE: 56 FR 23400, May 21, 1991, unless otherwise noted.

§ 20.1701 Use of process or other engineering controls.

The licensee shall use, to the extent practicable, process or other engineering controls (e.g., containment or ventilation) to control the concentrations of radioactive material in air.

§ 20.1702 Use of other controls.

When it is not practicable to apply process or other engineering controls to control the concentrations of radioactive material in air to values below those that define an airborne radioactivity area, the licensee shall, consistent with maintaining the total effective dose equivalent ALARA, increase monitoring and limit intakes by one or more of the following means:

- (a) Control of access;
- (b) Limitation of exposure times;
- (c) Use of respiratory protection equipment; or
- (d) Other controls.

§ 20.1703 Use of individual respiratory protection equipment.

(a) If the licensee uses respiratory protection equipment to limit intakes pursuant to § 20.1702—

(1) The licensee shall use only respiratory protection equipment that is tested and certified or had certification extended by the National Institute for Occupational Safety and

Health/Mine Safety and Health Administration (NIOSH/MSHA).

(2) If the licensee wishes to use equipment that has not been tested or certified by NIOSH/MSHA, has not had certification extended by NIOSH/MSHA, or for which there is no schedule for testing or certification, the licensee shall submit an application for authorized use of that equipment, including a demonstration by testing, or a demonstration on the basis of reliable test information, that the material and performance characteristics of the equipment are capable of providing the proposed degree of protection under anticipated conditions of use.

(3) The licensee shall implement and maintain a respiratory protection program that includes—

(i) Air sampling sufficient to identify the potential hazard, permit proper equipment selection, and estimate exposures;

(ii) Surveys and bioassays, as appropriate, to evaluate actual intakes;

(iii) Testing of respirators for operability immediately prior to each use;

(iv) Written procedures regarding selection, fitting, issuance, maintenance, and testing of respirators, including testing for operability immediately prior to each use; supervision and training of personnel; monitoring, including air sampling and bioassays; and recordkeeping; and

(v) Determination by a physician prior to initial fitting of respirators, and at least every 12 months thereafter, that the individual user is physically able to use the respiratory protection equipment.

(4) The licensee shall issue a written policy statement on respirator usage covering—

(i) The use of process or other engineering controls, instead of respirators;

(ii) The routine, nonroutine, and emergency use of respirators; and

(iii) The periods of respirator use and relief from respirator use.

(5) The licensee shall advise each respirator user that the user may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant de-

terioration of operating conditions, or any other conditions that might require such relief.

(6) The licensee shall use equipment within limitations for type and mode of use and shall provide proper visual, communication, and other special capabilities (such as adequate skin protection) when needed.

(b) In estimating exposure of individuals to airborne radioactive materials, the licensee may make allowance for respiratory protection equipment used to limit intakes pursuant to § 20.1702, provided that the following conditions, in addition to those in § 20.1703(a), are satisfied:

(1) The licensee selects respiratory protection equipment that provides a protection factor (see appendix A to §§ 20.1001-20.2401) greater than the multiple by which peak concentrations of airborne radioactive materials in the working area are expected to exceed the values specified in appendix B to §§ 20.1001-20.2401, table 1, column 3. If the selection of a respiratory protection device with a protection factor greater than the peak concentration is inconsistent with the goal specified in § 20.1702 of keeping the total effective dose equivalent ALARA, the licensee may select respiratory protection equipment with a lower protection factor only if such a selection would result in keeping the total effective dose equivalent ALARA. The concentration of radioactive material in the air that is inhaled when respirators are worn may be initially estimated by dividing the average concentration in air, during each period of uninterrupted use, by the protection factor. If the exposure is later found to be greater than estimated, the corrected value must be used; if the exposure is later found to be less than estimated, the corrected value may be used.

(2) The licensee shall obtain authorization from the Commission before assigning respiratory protection factors in excess of those specified in appendix A to §§ 20.1001-20.2401. The Commission may authorize a licensee to use higher protection factors on receipt of an application that—

(i) Describes the situation for which a need exists for higher protection factors, and

(ii) Demonstrates that the respiratory protection equipment provides these higher protection factors under the proposed conditions of use.

(c) The licensee shall use as emergency devices only respiratory protection equipment that has been specifically certified or had certification extended for emergency use by NOISH/MSHA.

(d) The licensee shall notify, in writing, the Director of the appropriate NRC Regional Office listed in appendix D to §§ 20.1001-20.2401 at least 30 days before the date that respiratory protection equipment is first used under the provisions of either § 20.1703 (a) or (b).

§ 20.1704 Further restrictions on the use of respiratory protection equipment.

The Commission may impose restrictions in addition to those in §§ 20.1702, 20.1703, and appendix A to §§ 20.1001-20.2401 to—

(a) Ensure that the respiratory protection program of the licensee is adequate to limit exposures of individuals to airborne radioactive materials; and

(b) Limit the extent to which a licensee may use respiratory protection equipment instead of process or other engineering controls.

Subpart I—Storage and Control of Licensed Material

SOURCE: 56 FR 23401, May 21, 1991, unless otherwise noted.

§ 20.1801 Security of stored material.

The licensee shall secure from unauthorized removal or access licensed materials that are stored in controlled or unrestricted areas.

§ 20.1802 Control of material not in storage.

The licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage.

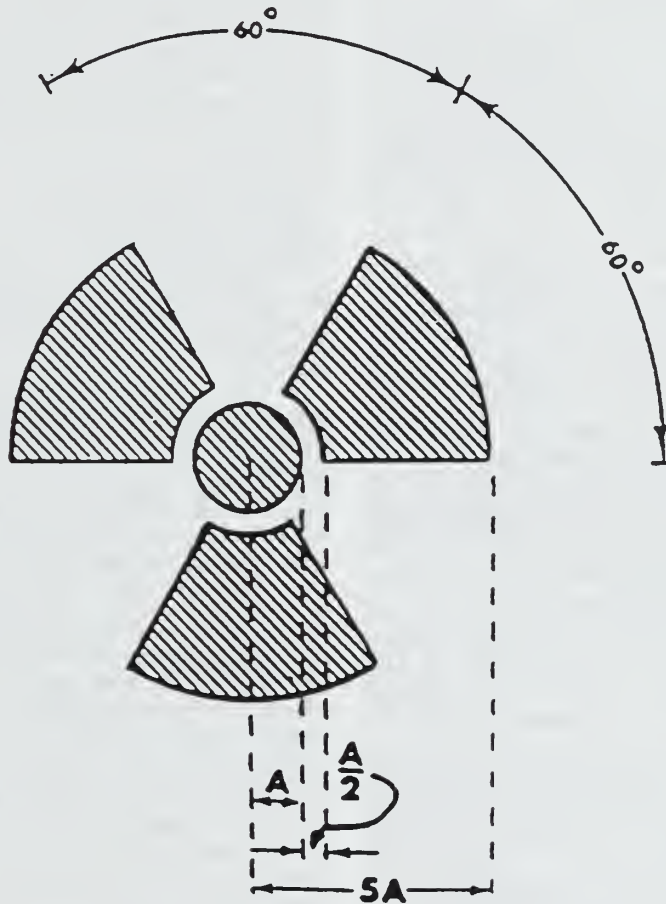
Subpart J—Precautionary Procedures

SOURCE: 56 FR 23401, May 21, 1991, unless otherwise noted.

§ 20.1901 Caution signs.

(a) *Standard radiation symbol.*
Unless otherwise authorized by the

Commission, the symbol prescribed by this part shall use the colors magenta, or purple, or black on yellow background. The symbol prescribed by this part is the three-bladed design:



RADIATION SYMBOL

(1) Cross-hatched area is to be magenta, or purple, or black, and

(2) The background is to be yellow.

(b) *Exception to color requirements for standard radiation symbol.* Notwithstanding the requirements of paragraph (a) of this section, licensees are authorized to label sources, source holders, or device components containing sources of licensed materials that are subjected to high temperatures, with conspicuously etched or stamped radiation caution symbols and without a color requirement.

(c) *Additional information on signs and labels.* In addition to the contents of signs and labels prescribed in this part, the licensee may provide, on or near the required signs and labels, additional information, as appropriate, to make individuals aware of potential radiation exposures and to minimize the exposures.

§ 20.1902 Posting requirements.

(a) *Posting of radiation areas.* The licensee shall post each radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIATION AREA."

(b) *Posting of high radiation areas.* The licensee shall post each high radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA."

(c) *Posting of very high radiation areas.* The licensee shall post each very high radiation area with a conspicuous sign or signs bearing the radiation symbol and words "GRAVE DANGER, VERY HIGH RADIATION AREA."

(d) *Posting of airborne radioactivity areas.* The licensee shall post each airborne radioactivity area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA."

(e) *Posting of areas or rooms in which licensed material is used or stored.* The licensee shall post each area or room in which there is used or stored an amount of licensed material exceeding 10 times the quantity of

such material specified in appendix C to §§ 20.1001-20.2401 with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL(S)" or "DANGER, RADIOACTIVE MATERIAL(S)."

§ 20.1903 Exceptions to posting requirements.

(a) A licensee is not required to post caution signs in areas or rooms containing radioactive materials for periods of less than 8 hours, if each of the following conditions is met:

(1) The materials are constantly attended during these periods by an individual who takes the precautions necessary to prevent the exposure of individuals to radiation or radioactive materials in excess of the limits established in this part; and

(2) The area or room is subject to the licensee's control.

(b) Rooms or other areas in hospitals that are occupied by patients are not required to be posted with caution signs pursuant to § 20.1902 provided that—

(1) The patient is being treated with sealed sources or has been treated with unsealed radioactive material in quantities less than 30 millicuries (110 MBq, or the measured dose rate at 1 meter from the patient is less than 0.005 rem (0.05 mSv) per hour; and

(2) There are personnel in attendance who will take the necessary precautions to prevent the exposure of individuals to radiation or radioactive material in excess of the limits established in this part and to operate within the ALARA provisions of the licensee's radiation protection program.

(c) A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level at 30 centimeters from the surface of the source container or housing does not exceed 0.005 rem (0.05 mSv) per hour.

§ 20.1904 Labeling containers.

(a) The licensee shall ensure that each container of licensed material bears a durable, clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE

MATERIAL" or "DANGER, RADIOACTIVE MATERIAL." The label must also provide sufficient information (such as the radionuclide(s) present, an estimate of the quantity of radioactivity, the date for which the activity is estimated, radiation levels, kinds of materials, and mass enrichment) to permit individuals handling or using the containers, or working in the vicinity of the containers, to take precautions to avoid or minimize exposures.

(b) Each licensee shall, prior to removal or disposal of empty uncontaminated containers to unrestricted areas, remove or deface the radioactive material label or otherwise clearly indicate that the container no longer contains radioactive materials.

§ 20.1905 Exemptions to labeling requirements.

A licensee is not required to label—

(a) Containers holding licensed material in quantities less than the quantities listed in appendix C to §§ 20.1001-20.2401; or

(b) Containers holding licensed material in concentrations less than those specified in table 3 of appendix B to §§ 20.1001-20.2401; or

(c) Containers attended by an individual who takes the precautions necessary to prevent the exposure of individuals in excess of the limits established by this part; or

(d) Containers when they are in transport and packaged and labeled in accordance with the regulations of the Department of Transportation,³ or

(e) Containers that are accessible only to individuals authorized to handle or use them, or to work in the vicinity of the containers, if the contents are identified to these individuals by a readily available written record (examples of containers of this type are containers in locations such as water-filled canals, storage vaults, or hot cells). The record must be re-

³ Labeling of packages containing radioactive materials is required by the Department of Transportation (DOT) if the amount and type of radioactive material exceeds the limits for an excepted quantity or article as defined and limited by DOT regulations 49 CFR 173.403 (m) and (w) and 173.421-424.

tained as long as the containers are in use for the purpose indicated on the record; or

(f) Installed manufacturing or process equipment, such as reactor components, piping, and tanks.

§ 20.1906 Procedures for receiving and opening packages.

(a) Each licensee who expects to receive a package containing quantities of radioactive material in excess of a Type A quantity, as defined in § 71.4 and appendix A to part 71 of this chapter, shall make arrangements to receive—

(1) The package when the carrier offers it for delivery; or

(2) Notification of the arrival of the package at the carrier's terminal and to take possession of the package expeditiously.

(b) Each licensee shall monitor the external surfaces of a package known to contain radioactive material for radioactive contamination and radiation levels if the package—

(1) Is labeled as containing radioactive material; or

(2) Has evidence of potential contamination, such as packages that are crushed, wet, or damaged.

(c) The licensee shall perform the monitoring required by paragraph (b) of this section as soon as practicable after receipt of the package, but not later than 3 hours after the package is received at the licensee's facility if it is received during the licensee's normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours.

(d) The licensee shall immediately notify the final delivery carrier and, by telephone and telegram, mailgram, or facsimile, the Administrator of the appropriate NRC Regional Office listed in appendix D to §§ 20.1001-20.2401 when—

(1) Removable radioactive surface contamination exceeds the limits of § 71.87(i) of this chapter; or

(2) External radiation levels exceed the limits of § 71.47 of this chapter.

(e) Each licensee shall—

(1) Establish, maintain, and retain written procedures for safely opening

packages in which radioactive material is received; and

(2) Ensure that the procedures are followed and that due consideration is given to special instructions for the type of package being opened.

(f) Licensees transferring special form sources in licensee-owned or licensee-operated vehicles to and from a work site are exempt from the contamination monitoring requirements of paragraph (b) of this section, but are not exempt from the survey requirement in paragraph (b) of this section for measuring radiation levels that is required to ensure that the source is still properly lodged in its shield.

Subpart K—Waste Disposal

SOURCE: 56 FR 23403, May 21, 1991, unless otherwise noted.

§ 20.2001 General requirements.

(a) A licensee shall dispose of licensed material only—

(1) By transfer to an authorized recipient as provided in § 20.2006 or in the regulations in parts 30, 40, 60, 61, 70, or 72 of this chapter; or

(2) By decay in storage; or

(3) By release in effluents within the limits in § 20.1301; or

(4) As authorized under §§ 20.2002, 20.2003, 20.2004, or § 20.2005.

(b) A person must be specifically licensed to receive waste containing licensed material from other persons for:

(1) Treatment prior to disposal; or

(2) Treatment or disposal by incineration; or

(3) Decay in storage; or

(4) Disposal at a land disposal facility licensed under part 61 of this chapter; or

(5) Disposal at a geologic repository under part 60 of this chapter.

§ 20.2002 Method for obtaining approval of proposed disposal procedures.

A licensee or applicant for a license may apply to the Commission for approval of proposed procedures, not otherwise authorized in the regulations in this chapter, to dispose of licensed material generated in the li-

censee's activities. Each application shall include:

(a) A description of the waste containing licensed material to be disposed of, including the physical and chemical properties important to risk evaluation, and the proposed manner and conditions of waste disposal; and

(b) An analysis and evaluation of pertinent information on the nature of the environment; and

(c) The nature and location of other potentially affected licensed and unlicensed facilities; and

(d) Analyses and procedures to ensure that doses are maintained ALARA and within the dose limits in this part.

§ 20.2003 Disposal by release into sanitary sewerage.

(a) A licensee may discharge licensed material into sanitary sewerage if each of the following conditions is satisfied:

(1) The material is readily soluble (or is readily dispersible biological material) in water; and

(2) The quantity of licensed or other radioactive material that the licensee releases into the sewer in 1 month divided by the average monthly volume of water released into the sewer by the licensee does not exceed the concentration listed in table 3 of appendix B to §§ 20.1001-20.2401; and

(3) If more than one radionuclide is released, the following conditions must also be satisfied:

(i) The licensee shall determine the fraction of the limit in table 3 of appendix B to §§ 20.1001-20.2401 represented by discharges into sanitary sewerage by dividing the actual monthly average concentration of each radionuclide released by the licensee into the sewer by the concentration of that radionuclide listed in table 3 of appendix B to §§ 20.1001-20.2401; and

(ii) The sum of the fractions for each radionuclide required by paragraph (a)(3)(i) of this section does not exceed unity; and

(4) The total quantity of licensed and other radioactive material that the licensee releases into the sanitary sewerage system in a year does not exceed 5 curies (185 GBq) of hydrogen-3, 1 curie (37 GBq) of carbon-14,

and 1 curie (37 GBq) of all other radioactive materials combined.

(b) Excreta from individuals undergoing medical diagnosis or therapy with radioactive material are not subject to the limitations contained in paragraph (a) of this section.

§ 20.2004 Treatment or disposal by incineration.

A licensee may treat or dispose of licensed material by incineration only in the amounts and forms specified in § 20.2005 or as specifically approved by the Commission pursuant to § 20.2002.

§ 20.2005 Disposal of specific wastes.

(a) A licensee may dispose of the following licensed material as if it were not radioactive:

(1) 0.05 microcurie (1.85 kBq), or less, of hydrogen-3 or carbon-14 per gram of medium used for liquid scintillation counting; and

(2) 0.05 microcurie (1.85 kBq), or less, of hydrogen-3 or carbon-14 per gram of animal tissue, averaged over the weight of the entire animal.

(b) A licensee may not dispose of tissue under paragraph (a)(2) of this section in a manner that would permit its use either as food for humans or as animal feed.

(c) The licensee shall maintain records in accordance with § 20.2108.

§ 20.2006 Transfer for disposal and manifests.

(a) The requirements of this section and appendix F to §§ 20.1001-20.2401 are designed to control transfers of low-level radioactive waste intended for disposal at a land disposal facility (as defined in part 61 of this chapter), establish a manifest tracking system, and supplement existing requirements concerning transfers and recordkeeping for those wastes.

(b) Each shipment of radioactive waste intended for disposal at a licensed land disposal facility must be accompanied by a shipment manifest as specified in section I of appendix F to §§ 20.1001-20.2401.

(c) Each shipment manifest must include a certification by the waste generator as specified in section II of appendix F to §§ 20.1001-20.2401.

(d) Each person involved in the transfer for disposal and disposal of waste, including the waste generator, waste collector, waste processor, and disposal facility operator, shall comply with the requirements specified in section III of appendix F to §§ 20.1001-20.2401.

§ 20.2007 Compliance with environmental and health protection regulations.

Nothing in this subpart relieves the licensee from complying with other applicable Federal, State, and local regulations governing any other toxic or hazardous properties of materials that may be disposed of under this subpart.

Subpart L—Records

SOURCE: 56 FR 23404, May 21, 1991, unless otherwise noted.

§ 20.2101 General provisions.

(a) Each licensee shall use the units: curie, rad, rem, including multiples and subdivisions, and shall clearly indicate the units of all quantities on records required by this part.

(b) The licensee shall make a clear distinction among the quantities entered on the records required by this part (e.g., total effective dose equivalent, shallow-dose equivalent, eye dose equivalent, deep-dose equivalent, committed effective dose equivalent).

§ 20.2102 Records of radiation protection programs.

(a) Each licensee shall maintain records of the radiation protection program, including:

(1) The provisions of the program; and

(2) Audits and other reviews of program content and implementation.

(b) The licensee shall retain the records required by paragraph (a)(1) of this section until the Commission terminates each pertinent license requiring the record. The licensee shall retain the records required by paragraph (a)(2) of this section for 3 years after the record is made.

§ 20.2103 Records of surveys.

(a) Each licensee shall maintain records showing the results of surveys and calibrations required by §§ 20.1501 and 20.1906(b). The licensee shall retain these records for 3 years after the record is made.

(b) The licensee shall retain each of the following records until the Commission terminates each pertinent license requiring the record:

(1) Records of the results of surveys to determine the dose from external sources and used, in the absence of or in combination with individual monitoring data, in the assessment of individual dose equivalents; and

(2) Records of the results of measurements and calculations used to determine individual intakes of radioactive material and used in the assessment of internal dose; and

(3) Records showing the results of air sampling, surveys, and bioassays required pursuant to § 20.1703(a)(3) (i) and (ii); and

(4) Records of the results of measurements and calculations used to evaluate the release of radioactive effluents to the environment.

§ 20.2104 Determination of prior occupational dose.

(a) For each individual who may enter the licensee's restricted or controlled area and is likely to receive, in a year, an occupational dose requiring monitoring pursuant to § 20.1502, the licensee shall—

(1) Determine the occupational radiation dose received during the current year; and

(2) Attempt to obtain the records of lifetime cumulative occupational radiation dose.

(b) Prior to permitting an individual to participate in a planned special exposure, the licensee shall determine—

(1) The internal and external doses from all previous planned special exposures; and

(2) All doses in excess of the limits (including doses received during accidents and emergencies) received during the lifetime of the individual.

(c) In complying with the requirements of paragraph (a) of this section, a licensee may—

(1) Accept, as a record of the occupational dose that the individual received during the current year, a written signed statement from the individual or from the individual's most recent employer for work involving radiation exposure, that discloses the nature and the amount of any occupational dose that the individual may have received during the current year;

(2) Accept, as the record of lifetime cumulative radiation dose, an up-to-date NRC Form 4, or equivalent, signed by the individual and countersigned by an appropriate official of the most recent employer for work involving radiation exposure, or the individual's current employer (if the individual is not employed by the licensee); and

(3) Obtain reports of the individual's dose equivalent(s) from the most recent employer for work involving radiation exposure, or the individual's current employer (if the individual is not employed by the licensee) by telephone, telegram, electronic media, or letter. The licensee shall request a written verification of the dose data if the authenticity of the transmitted report cannot be established.

(d) The licensee shall record the exposure history, as required by paragraph (a) of this section, on NRC Form 4, or other clear and legible record, of all the information required on that form.⁴ The form or record must show each period in which the individual received occupational exposure to radiation or radioactive material and must be signed by the individual who received the exposure. For each period for which the licensee obtains reports, the licensee shall use the dose shown in the report in preparing NRC Form 4. For any period in which the licensee does not obtain a report,

⁴ Licensees are not required to reevaluate the separate external dose equivalents and internal committed dose equivalents or intakes of radionuclides assessed under §§ 20.1-20.601. Further, occupational exposure histories obtained and recorded on NRC Form 4 before January 1, 1991, would not have included effective dose equivalent, but may be used in the absence of specific information on the intake of radionuclides by the individual.

the licensee shall place a notation on NRC Form 4 indicating the periods of time for which data are not available.

(e) If the licensee is unable to obtain a complete record of an individual's current and previously accumulated occupational dose, the licensee shall assume—

(1) In establishing administrative controls under § 20.1201(f) for the current year, that the allowable dose limit for the individual is reduced by 1.25 rems (12.5 mSv) for each quarter for which records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure; and

(2) That the individual is not available for planned special exposures.

(f) The licensee shall retain the records on NRC Form 4 or equivalent until the Commission terminates each pertinent license requiring this record. The licensee shall retain records used in preparing NRC Form 4 for 3 years after the record is made.

§ 20.2105 Records of planned special exposures.

(a) For each use of the provisions of § 20.1206 for planned special exposures, the licensee shall maintain records that describe—

(1) The exceptional circumstances requiring the use of a planned special exposure; and

(2) The name of the management official who authorized the planned special exposure and a copy of the signed authorization; and

(3) What actions were necessary; and
(4) Why the actions were necessary; and

(5) How doses were maintained ALARA; and

(6) What individual and collective doses were expected to result, and the doses actually received in the planned special exposure.

(b) The licensee shall retain the records until the Commission terminates each pertinent license requiring these records.

§ 20.2106 Records of individual monitoring results.

(a) *Recordkeeping requirement.* Each licensee shall maintain records of doses received by all individuals for

whom monitoring was required pursuant to § 20.1502, and records of doses received during planned special exposures, accidents, and emergency conditions. These records^a must include, when applicable—

(1) The deep-dose equivalent to the whole body, eye dose equivalent, shallow-dose equivalent to the skin, and shallow-dose equivalent to the extremities; and

(2) The estimated intake or body burden of radionuclides (see § 20.1202); and

(3) The committed effective dose equivalent assigned to the intake or body burden of radionuclides; and

(4) The specific information used to calculate the committed effective dose equivalent pursuant to § 20.1204(c); and

(5) The total effective dose equivalent when required by § 20.1202; and

(6) The total of the deep-dose equivalent and the committed dose to the organ receiving the highest total dose.

(b) *Recordkeeping frequency.* The licensee shall make entries of the records specified in paragraph (a) of this section at least annually.

(c) *Recordkeeping format.* The licensee shall maintain the records specified in paragraph (a) of this section on NRC Form 5, in accordance with the instructions for NRC Form 5, or in clear and legible records containing all the information required by NRC Form 5.

(d) *Privacy protection.* The records required under this section should be protected from public disclosure because of their personal privacy nature. These records are protected by most State privacy laws and, when transferred to the NRC, are protected by the Privacy Act of 1974, Public Law 93-579, 5 U.S.C. 552a, and the Commission's regulations in 10 CFR part 9.

(e) The licensee shall maintain the records of dose to an embryo/fetus with the records of dose to the declared pregnant woman. The declaration of pregnancy shall also be kept on

^a Assessments of dose equivalent and records made using units in effect before the licensee's adoption of this part need not be changed.

file, but may be maintained separately from the dose records.

(f) The licensee shall retain each required form or record until the Commission terminates each pertinent license requiring the record.

§ 20.2107 Records of dose to individual members of the public.

(a) Each licensee shall maintain records sufficient to demonstrate compliance with the dose limit for individual members of the public (see § 20.1301).

(b) The licensee shall retain the records required by paragraph (a) of this section until the Commission terminates each pertinent license requiring the record.

§ 20.2108 Records of waste disposal.

(a) Each licensee shall maintain records of the disposal of licensed materials made under §§ 20.2002, 20.2003, 20.2004, 20.2005, 10 CFR part 61 and disposal by burial in soil, including burials authorized before January 28, 1981.*

(b) The licensee shall retain the records required by paragraph (a) of this section until the Commission terminates each pertinent license requiring the record.

§ 20.2109 Records of testing entry control devices for very high radiation areas.

(a) Each licensee shall maintain records of tests made under § 20.1603(a)(9) on entry control devices for very high radiation areas. These records must include the date, time, and results of each such test of function.

(b) The licensee shall retain the records required by paragraph (a) of this section for 3 years after the record is made.

§ 20.2110 Form of records.

Each record required by this part must be legible throughout the specified retention period. The record may be the original or a reproduced copy or a microform provided that the copy or

microform is authenticated by authorized personnel and that the microform is capable of producing a clear copy throughout the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records, such as letters, drawings, and specifications, must include all pertinent information, such as stamps, initials, and signatures. The licensee shall maintain adequate safeguards against tampering with and loss of records.

Subpart M—Reports

SOURCE: 56 FR 23406, May 21, 1991, unless otherwise noted.

§ 20.2201 Reports of theft or loss of licensed material.

(a) Telephone reports. (1) Each licensee shall report by telephone as follows:

(i) Immediately after its occurrence becomes known to the licensee, any lost, stolen, or missing licensed material in an aggregate quantity equal to or greater than 1,000 times the quantity specified in appendix C to §§ 20.1001-20.2401 under such circumstances that it appears to the licensee that an exposure could result to persons in unrestricted areas; or

(ii) Within 30 days after the occurrence of any lost, stolen, or missing licensed material becomes known to the licensee, all licensed material in a quantity greater than 10 times the quantity specified in appendix C to §§ 20.1001-20.2401 that is still missing at this time.

(2) Reports must be made as follows:

(i) Licensees having an installed Emergency Notification System shall make the reports to the NRC Operations Center in accordance with § 50.72 of this chapter, and

(ii) All other licensees shall make reports to the NRC Operations Center.

(b) *Written reports.* (1) Each licensee required to make a report under paragraph (a) of this section shall, within 30 days after making the telephone report, make a written report setting forth the following information:

* A previous § 20.304 permitted burial of small quantities of licensed materials in soil before January 28, 1981, without specific Commission authorization.

(i) A description of the licensed material involved, including kind, quantity, and chemical and physical form; and

(ii) A description of the circumstances under which the loss or theft occurred; and

(iii) A statement of disposition, or probable disposition, of the licensed material involved; and

(iv) Exposures of individuals to radiation, circumstances under which the exposures occurred, and the possible total effective dose equivalent to persons in unrestricted areas; and

(v) Actions that have been taken, or will be taken, to recover the material; and

(vi) Procedures or measures that have been, or will be, adopted to ensure against a recurrence of the loss or theft of licensed material.

(2) Reports must be made as follows:

(i) For holders of an operating license for a nuclear power plant, the events included in paragraph (b) of this section must be reported in accordance with the procedures described in § 50.73(b), (c), (d), (e), and (g) of this chapter and must include the information required in paragraph (b)(1) of this section, and

(ii) All other licensees shall make reports to the Administrator of the appropriate NRC Regional Office listed in appendix D to §§ 20.1001-20.2401.

(c) A duplicate report is not required under paragraph (b) of this section if the licensee is also required to submit a report pursuant to §§ 30.55(c), 40.64(c), 50.72, 50.73, 70.52, 73.27(b), 73.67(e)(3)(vi), 73.67(g)(3)(iii), 73.71, or § 150.19(c) of this chapter.

(d) Subsequent to filing the written report, the licensee shall also report any additional substantive information on the loss or theft within 30 days after the licensee learns of such information.

(e) The licensee shall prepare any report filed with the Commission pursuant to this section so that names of individuals who may have received exposure to radiation are stated in a separate and detachable part of the report.

§ 20.2202 Notification of incidents.

(a) Immediate notification. Notwithstanding any other requirements for notification, each licensee shall immediately report any event involving by-product, source, or special nuclear material possessed by the licensee that may have caused or threatens to cause any of the following conditions—

(1) An individual to receive—

(i) A total effective dose equivalent of 25 rems (0.25 Sv) or more; or

(ii) An eye dose equivalent of 75 rems (0.75 Sv) or more; or

(iii) A shallow-dose equivalent to the skin or extremities of 250 rads (2.5 Gy) or more; or

(2) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours, the individual could have received an intake five times the occupational annual limit on intake (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).

(b) Twenty-four hour notification. Each licensee shall, within 24 hours of discovery of the event, report any event involving loss of control of licensed material possessed by the licensee that may have caused, or threatens to cause, any of the following conditions:

(1) An individual to receive, in a period of 24 hours—

(i) A total effective dose equivalent exceeding 5 rems (0.05 Sv); or

(ii) An eye dose equivalent exceeding 15 rems (0.15 Sv); or

(iii) A shallow-dose equivalent to the skin or extremities exceeding 50 rems (0.5 Sv); or

(2) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours, the individual could have received an intake in excess of one occupational annual limit on intake (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).

(c) The licensee shall prepare any report filed with the Commission pur-

suant to this section so that names of individuals who have received exposure to radiation or radioactive material are stated in a separate and detachable part of the report.

(d) Reports made by licensees in response to the requirements of this section must be made as follows:

(1) Licensees having an installed Emergency Notification System shall make the reports required by paragraphs (a) and (b) of this section to the NRC Operations Center in accordance with 10 CFR 50.72; and

(2) All other licensees shall make the reports required by paragraphs (a) and (b) of this section by telephone to the NRC Operations Center and by telegram, mailgram, or facsimile to the Administrator of the appropriate NRC Regional Office listed in appendix D to §§ 20.1001-20.2401.

(e) The provisions of this section do not include doses that result from planned special exposures, that are within the limits for planned special exposures, and that are reported under § 20.2204.

[56 FR 23406, May 21, 1991, as amended at 56 FR 40766, Aug. 16, 1991]

§ 20.2203 Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the limits.

(a) Reportable events. In addition to the notification required by § 20.2202, each licensee shall submit a written report within 30 days after learning of any of the following occurrences:

(1) Any incident for which notification is required by § 20.2202; or

(2) Doses in excess of any of the following:

(i) The occupational dose limits for adults in § 20.1201; or

(ii) The occupational dose limits for a minor in § 20.1207; or

(iii) The limits for an embryo/fetus of a declared pregnant woman in § 20.1208; or

(iv) The limits for an individual member of the public in § 20.1301; or

(v) Any applicable limit in the license; or

(3) Levels of radiation or concentrations of radioactive material in—

(i) A restricted area in excess of any applicable limit in the license; or

(ii) An unrestricted area in excess of 10 times any applicable limit set forth in this part or in the license (whether or not involving exposure of any individual in excess of the limits in § 20.1301); or

(4) For licensees subject to the provisions of EPA's generally applicable environmental radiation standards in 40 CFR part 190, levels of radiation or releases of radioactive material in excess of those standards, or of license conditions related to those standards.

(b) Contents of reports. (1) Each report required by paragraph (a) of this section must describe the extent of exposure of individuals to radiation and radioactive material, including, as appropriate:

(i) Estimates of each individual's dose; and

(ii) The levels of radiation and concentrations of radioactive material involved; and

(iii) The cause of the elevated exposures, dose rates, or concentrations; and

(iv) Corrective steps taken or planned to ensure against a recurrence, including the schedule for achieving conformance with applicable limits, generally applicable environmental standards, and associated license conditions.

(2) Each report filed pursuant to paragraph (a) of this section must include for each individual⁷ exposed: the name, Social Security account number, and date of birth. The report must be prepared so that this information is stated in a separate and detachable part of the report.

(c) For holders of an operating license for a nuclear power plant, the occurrences included in paragraph (a) of this section must be reported in accordance with the procedures described in § 50.73(b), (c), (d), (e), and (g) of this chapter and must also include the information required by paragraph (b) of this section. Occurrences reported in accordance with § 50.73 of this chapter need not be re-

⁷ With respect to the limit for the embryo-fetus (§ 20.1208), the identifiers should be those of the declared pregnant woman.

ported by a duplicate report under paragraph (a) of this section.

(d) All licensees, other than those holding an operating license for a nuclear power plant, who make reports under paragraph (a) of this section shall submit the report in writing to the U.S. Nuclear Regulatory Commission, Document Control Desk, Washington, DC 20555, with a copy to the appropriate NRC Regional Office listed in appendix D to §§ 20.1001-20.2401.

§ 20.2204 Reports of planned special exposures.

The licensee shall submit a written report to the Administrator of the appropriate NRC Regional Office listed in appendix D to §§ 20.1001-20.2401 within 30 days following any planned special exposure conducted in accordance with § 20.1206, informing the Commission that a planned special exposure was conducted and indicating the date the planned special exposure occurred and the information required by § 20.2105.

20.2205 [Reserved]

20.2206 Reports of individual monitoring.

(a) This section applies to each person licensed by the Commission

(1) Operate a nuclear reactor designed to produce electrical or heat energy pursuant to § 50.21(b) or 50.22 of this chapter or a testing facility as defined in § 50.2 of this chapter; or

(2) Possess or use byproduct material for purposes of radiography pursuant to Parts 30 and 34 of this chapter; or

(3) Possess or use at any one time, for purposes of fuel processing, fabricating, or reprocessing, special nuclear material in a quantity exceeding 5,000 grams of contained uranium-235, uranium-233, or plutonium, or any combination thereof pursuant to part 70 of this chapter; or

(4) Possess high-level radioactive waste at a geologic repository operations area pursuant to part 60 of this chapter; or

(5) Possess spent fuel in an independent spent fuel storage installation (ISFSI) pursuant to part 72 of this chapter; or

(6) Receive radioactive waste from other persons for disposal under part 61 of this chapter; or

(7) Possess or use at any time, for processing or manufacturing for distribution pursuant to parts 30, 32, 33 or 35 of this chapter, byproduct material in quantities exceeding any one of the following quantities:

Radionuclide	Quantity of radionuclide ¹ in curies
Cesium-137	1
Cobalt-60	1
Gold-198	100
Iodine-131	1
Iridium-192	10
Krypton-85	1,000
Promethium-147	10
Technetium-99m	1,000

¹ The Commission may require as a license condition, or by rule, regulation, or order pursuant to § 20.2302, reports from licensees who are licensed to use radionuclides not on this list, in quantities sufficient to cause comparable radiation levels.

(b) Each licensee in a category listed in paragraph (a) of this section shall submit an annual report of the results of individual monitoring carried out by the licensee for each individual for whom monitoring was required by § 20.1502 during that year. The licensee may include additional data for individuals for whom monitoring was provided but not required. The licensee shall use Form NRC 5 or electronic media containing all the information required by Form NRC 5.

(c) The licensee shall file the report required by § 20.2206(b), covering the preceding year, on or before April 30 of each year. The licensee shall submit the report to the REIRS Project Manager, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

[56 FR 23406, May 21, 1991, as amended at 56 FR 32072, July 15, 1991]

Subpart N—Exemptions and Additional Requirements

SOURCE: 56 FR 23408, May 21, 1991, unless otherwise noted.

§ 20.2301 Applications for exemptions.

The Commission may, upon application by a licensee or upon its own initiative, grant an exemption from the requirements of the regulations in this part if it determines the exemption is authorized by law and would not result in undue hazard to life or property.

§ 20.2302 Additional requirements.

The Commission may, by rule, regulation, or order, impose requirements on a licensee, in addition to those established in the regulations in this part, as it deems appropriate or necessary to protect health or to minimize danger to life or property.

Subpart O—Enforcement

§ 20.2401 Violations.

(a) The Commission may obtain an injunction or other court order to prevent a violation of the provisions of—

(1) The Atomic Energy Act of 1954, as amended;

(2) Title II of the Energy Reorganization Act of 1974, as amended; or

(3) A regulation or order issued pursuant to those Acts.

(b) The Commission may obtain a court order for the payment of a civil penalty imposed under section 234 of the Atomic Energy Act:

(1) For violations of—

(i) Sections 53, 57, 62, 63, 81, 82, 101, 103, 104, 107 or 109 of the Atomic Energy Act of 1954, as amended;

(ii) Section 206 of the Energy Reorganization Act;

(iii) Any rule, regulation, or order issued pursuant to the sections specified in paragraph (b)(1)(i) of this section;

(iv) Any term, condition, or limitation of any license issued under the sections specified in paragraph (b)(1)(i) of this section.

(2) For any violation for which a license may be revoked under Section 186 of the Atomic Energy Act of 1954, as amended.

(c) Any person who willfully violates a provision of the Atomic Energy Act or regulation or order issued under the requirements of that Act may be guilty of a crime and, upon conviction, be punished by fine or imprisonment or both, as provided by law.

[56 FR 23408, May 21, 1991; 56 FR 61352, Dec. 3, 1991]

APPENDICES TO §§ 20.1001—20.2401 OF PART 20

APPENDIX A TO §§ 20.1001—20.2401—PROTECTION FACTORS FOR RESPIRATORS *

Description *	Protection Factors *			Tested & Certified Equipment National Institute for Occupational Safety and Health/Mine Safety and Health Administration tests for permissibility
	Modes *	Particulates only	Particulates, gases, & vapors *	
I. Air-Purifying Respirators: *				
Facepiece, half-mask	NP	10		30 CFR Part 11, Subpart K.
Facepiece, full	NP	50		
Facepiece, half-mask full, or hood	PP	1000		
II. Atmosphere-Supplying Respirators:				
1. Air-line respirator:				
Facepiece, half-mask	CF		1000	30 CFR Part 11, Subpart J.
Facepiece, half-mask	D		5	
Facepiece, full	CF		2000	
Facepiece, full	D		5	
Facepiece, full	PD		2000	
Hood	CF		(*)	
Suit	CF		(*) (*)	
2. Self-contained breathing appa- ratus (SCBA):				
Facepiece, full	D		50	30 CFR Part 11, Subpart H.
Facepiece, full	PD		* 10,000	
Facepiece, full	RD		50	

APPENDIX A TO §§ 20.1001-20.2401—PROTECTION FACTORS FOR RESPIRATORS *—Continued

Description *	Protection Factors *			Tested & Certified Equipment
	Modes *	Particulates only	Particulates, gases, & vapors *	
Facepiece, full..... RP			5,000	National Institute for Occupational Safety and Health/Mine Safety and Health Administration tests for permissibility
III. Combination Respirators:				
Any combination of air-purifying and atmosphere-supplying respirators.			Protection factor for type and mode of operation as listed above.	30 CFR Part 11, § 11.63(b).

Footnotes

a. For use in the selection of respiratory protective devices to be used only where the contaminants have been identified and the concentrations (or possible concentrations) are known.

b. Only for shaven faces and where nothing interferes with the seal of tight-fitting facepieces against the skin. (Hoods and suits are excepted)

c. The mode symbols are defined as follows:

CF = continuous flow

D = demand

NP = negative pressure (i.e., negative phase during inhalation)

PD = pressure demand (i.e., always positive pressure)

PP = positive pressure

RD = demand, recirculating (closed circuit)

RP = pressure demand, recirculating (closed circuit)

d.1. The protection factor is a measure of the degree of protection afforded by a respirator, defined as the ratio of the concentration of airborne radioactive material outside the respiratory protective equipment to that inside the equipment (usually inside the facepiece) under conditions of use. It is applied to the ambient airborne concentration to estimate the concentrations inhaled by the wearer according to the following formula:

$$\text{Concentration inhaled} = \frac{\text{Ambient airborne concentration}}{\text{Protection factor}}$$

2. The protection factors apply:

(a) Only for individuals trained in using respirators and wearing properly fitted respirators that are used and maintained under supervision in a well-planned respiratory protective program.

(b) For air-purifying respirators only when high efficiency particulate filters (above 99.97% removal efficiency by thermally generated 0.3 μm dioctyl phthalate (DOP) test or equivalent) are used in atmospheres not deficient in oxygen and not containing radioactive gas or vapor respiratory hazards.

(c) No adjustment is to be made for the use of sorbents against radioactive material in the form of gases or vapors.

(d) For atmosphere-supplying respirators only when supplied with adequate respirable air. Respirable air shall be provided of the quality and quantity required in accordance with NIOSH/MSHA certification (described in 30 CFR part 11). Oxygen and air shall not be used in the same apparatus.

e. Excluding radioactive contaminants that present an absorption or submersion hazard. For tritium oxide, approximately one-third of the intake occurs by absorption

through the skin so that an overall protection factor of less than 2 is appropriate when atmosphere-supplying respirators are used to protect against tritium oxide. If the protection factor for a device is 5 the effective protection factor for tritium is about 1.4; for devices with protection factors of 10 the effective factor for tritium oxide is about 1.7, and for devices with protection factors of 100 or more the effective factor for tritium oxide is about 1.9. Air-purifying respirators are not suitable for protection against tritium oxide. See also footnote 1 concerning supplied-air suits.

f. Canisters and cartridges shall not be used beyond service-life limitations.

g. Under-chin type only. This type of respirator is not satisfactory for use where it might be possible (e.g., if an accident or emergency were to occur) for the ambient airborne concentrations to reach instantaneous values greater than 10 times the pertinent values in table 1, column 3 of appendix B to §§ 20.1001-20.2401 of this part. This type of respirator is not suitable for protection against plutonium or other high-toxicity materials. The mask is to be tested for fit prior to use, each time it is donned.

h.1. Equipment shall be operated in a manner that ensures that proper air flow-rates are maintained. A protection factor of no more than 1000 may be utilized for tested-and-certified supplied-air hoods when a minimum air flow of 6 cubic feet (0.17 cubic meters) per minute is maintained and calibrated air-line pressure gauges or flow measuring devices are used. A protection factor of up to 2000 may be used for tested and certified hoods only when the air flow is maintained at the manufacturer's recommended maximum rate for the equipment, this rate is greater than 6 cubic feet (0.17 cubic meters) per minute, and calibrated air-line pressure gauges or flow measuring devices are used.

2. The design of the supplied-air hood or helmet (with a minimum flow of 6 cfm (0.17 m³ per minute) of air) may determine its overall efficiency and the protection it provides. For example, some hoods aspirate contaminated air into the breathing zone when the wearer works with hands-over-head. This aspiration may be overcome if a short cape-like extension to the hood is worn under a coat or overalls. Other limitations specified by the approval agency shall be considered before using a hood in certain types of atmospheres (see footnote 1).

1. Appropriate protection factors shall be determined, taking into account the design of the suit and its permeability to the contaminant under conditions of use. There shall be a standby rescue person equipped with a respirator or other apparatus appropriate for the potential hazards and communications equipment whenever supplied-air suits are used.

j. No approval schedules are currently available for this equipment. Equipment is to be evaluated by testing or on the basis of reliable test information.

k. This type of respirator may provide greater protection and be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure, such as skin absorption, must be taken into account in such circumstances.

1. Quantitative fit testing shall be performed on each individual and no more than 0.02% leakage is allowed with this type of apparatus. Perceptible outward leakage of gas from this or any positive pressure self-contained breathing apparatus is unacceptable because service life will be reduced substantially. Special training in the use of this type of apparatus shall be provided to the wearer.

NOTE 1: Protection factors for respirators as may be approved by the U.S. Bureau of Mines/National Institute for Occupational Safety and Health (NIOSH), according to applicable approvals for respirators for type and mode of use to protect against airborne

radionuclides, may be used to the extent that they do not exceed the protection factors listed in this table. The protection factors listed in this table may not be appropriate to circumstances where chemical or other respiratory hazards exist in addition to radioactive hazards. The selection and use of respirators for such circumstances should take into account applicable approvals of the U.S. Bureau of Mines/NIOSH.

NOTE 2: Radioactive contaminants for which the concentration values in Table 1, Column 3 of Appendix B to §§ 20.1001-20.2401 of this part are based on internal dose due to inhalation may, in addition, present external exposure hazards at higher concentrations. Under these circumstances, limitations on occupancy may have to be governed by external dose limits.

[56 FR 23408, May 21, 1991]

APPENDIX B TO §§ 20.1001—20.2401— ANNUAL LIMITS ON INTAKE (ALIs) AND DERIVED AIR CONCENTRATIONS (DACs) OF RADIONUCLIDES FOR OCCU- PATIONAL EXPOSURE; EFFLUENT CON- CENTRATIONS; CONCENTRATIONS FOR RELEASE TO SEWERAGE

Introduction

For each radionuclide Table 1 indicates the chemical form which is to be used for selecting the appropriate ALI or DAC value. The ALIs and DACs for inhalation are given for an aerosol with an activity median aerodynamic diameter (AMAD) of 1 μ m and for three classes (D,W,Y) of radioactive material, which refer to their retention (approximately days, weeks or years) in the pulmonary region of the lung. This classification applies to a range of clearance half-times of less than 10 days for D, for W from 10 to 100 days, and for Y greater than 100 days. Table 2 provides concentration limits for airborne and liquid effluents released to the general environment. Table 3 provides concentration limits for discharges to sanitary sewer systems.

Notation

The values in Tables 1, 2, and 3 are presented in the computer "E" notation. In this notation a value of 6E-02 represents a value of 6×10^{-2} or 0.06, 6E+2 represents 6×10^2 or 600, and 6E+0 represents 6×10^0 or 6.

Table 1 "Occupational"

Note that the columns in Table 1, of this appendix captioned "Oral Ingestion ALI," "Inhalation ALI," and "DAC," are applicable to occupational exposure to radioactive material.

The ALIs in this appendix are the annual intakes of a given radionuclide by "Reference Man" which would result in either (1) a committed effective dose equivalent of 5 rems (stochastic ALI) or (2) a committed dose equivalent of 50 rems to an organ or tissue (non-stochastic ALI). The stochastic ALIs were derived to result in a risk, due to irradiation of organs and tissues, comparable to the risk associated with deep dose equivalent to the whole body of 5 rems. The derivation includes multiplying the committed dose equivalent to an organ or tissue by a weighting factor, w_T . This weighting factor is the proportion of the risk of stochastic effects resulting from irradiation of the organ or tissue, T , to the total risk of stochastic effects when the whole body is irradiated uniformly. The values of w_T are listed under the definition of weighting factor in § 20.1003. The non-stochastic ALIs were derived to avoid non-stochastic effects, such as prompt damage to tissue or reduction in organ function.

A value of $w_T = 0.06$ is applicable to each of the five organs or tissues in the "remainder" category receiving the highest dose equivalents, and the dose equivalents of all other remaining tissues may be disregarded. The following parts of the GI tract—stomach, small intestine, upper large intestine, and lower large intestine—are to be treated as four separate organs.

Note that the dose equivalents for extremities (hands and forearms, feet and lower legs), skin, and lens of the eye are not considered in computing the committed effective dose equivalent, but are subject to limits that must be met separately.

When an ALI is defined by the stochastic dose limit, this value alone, is given. When an ALI is determined by the non-stochastic dose limit to an organ, the organ or tissue to which the limit applies is shown, and the ALI for the stochastic limit is shown in parentheses. (Abbreviated organ or tissue designations are used: LLI wall = lower large intestine wall; St. wall = stomach wall; Blad wall = bladder wall; and Bone surf = bone surface.)

The use of the ALIs listed first, the more limiting of the stochastic and non-stochastic ALIs, will ensure that non-stochastic effects are avoided and that the risk of stochastic effects is limited to an acceptably low value. If, in a particular situation involving a radionuclide for which the non-stochastic ALI is limiting, use of that non-stochastic ALI is considered unduly conservative, the licensee may use the stochastic ALI to determine the committed effective dose equivalent. However, the licensee shall also ensure that the 50-rem dose equivalent limit for any organ or tissue is not exceeded by the sum of the external deep dose equivalent plus the internal committed dose to that organ (not the effective dose). For the case where

there is no external dose contribution, this would be demonstrated if the sum of the fractions of the nonstochastic ALIs (ALI_{ns}) that contribute to the committed dose equivalent to the organ receiving the highest dose does not exceed unity (i.e., $\sum (\text{intake (in } \mu\text{Ci) of each radionuclide} / ALI_{ns}) < 1.0$). If there is an external deep dose equivalent contribution of H_d then this sum must be less than $1 - (H_d/50)$ instead of being < 1.0 .

Note that the dose equivalents for extremities (hand and forearms, feet and lower legs), skin, and lens of the eye are not considered in computing the committed effective dose equivalent, but are subject to limits that must be met separately.

The derived air concentration (DAC) values are derived limits intended to control chronic occupational exposures. The relationship between the DAC and the ALI is given by: $DAC = ALI(\text{in } \mu\text{Ci}) / (2000 \text{ hours per working year} \times 60 \text{ minutes/hour} \times 2 \times 10^4 \text{ ml per minute}) = [ALI / 2.4 \times 10^7] \mu\text{Ci/ml}$, where $2 \times 10^4 \text{ ml}$ is the volume of air breathed per minute at work by "Reference Man" under working conditions of "light work."

The DAC values relate to one of two modes of exposure: either external submersion or the internal committed dose equivalents resulting from inhalation of radioactive materials. Derived air concentrations based upon submersion are for immersion in a semi-infinite cloud of uniform concentration and apply to each radionuclide separately.

The ALI and DAC values relate to exposure to the single radionuclide named, but also include contributions from the ingrowth of any daughter radionuclide produced in the body by the decay of the parent. However, intakes that include both the parent and daughter radionuclides should be treated by the general method appropriate for mixtures.

The value of ALI and DAC do not apply directly when the individual both ingests and inhales a radionuclide, when the individual is exposed to a mixture of radionuclides by either inhalation or ingestion or both, or when the individual is exposed to both internal and external radiation (see § 20.1202). When an individual is exposed to radioactive materials which fall under several of the translocation classifications (i.e., Class D, Class W, or Class Y) of the same radionuclide, the exposure may be evaluated as if it were a mixture of different radionuclides.

It should be noted that the classification of a compound as Class D, W, or Y is based on the chemical form of the compound and does not take into account the radiological half-life of different radioisotopes. For this reason, values are given for Class D, W, and

Y compounds, even for very short-lived radionuclides.

Table 2

The columns in Table 2 of this appendix captioned "Effluents," "Air," and "Water," are applicable to the assessment and control of dose to the public, particularly in the implementation of the provisions of § 20.1302. The concentration values given in Columns 1 and 2 of Table 2 are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem (50 millirem or 0.5 millisieverts).

Consideration of non-stochastic limits has not been included in deriving the air and water effluent concentration limits because non-stochastic effects are presumed not to occur at the dose levels established for individual members of the public. For radionuclides, where the non-stochastic limit was governing in deriving the occupational DAC, the stochastic ALI was used in deriving the corresponding airborne effluent limit in Table 2. For this reason, the DAC and airborne effluent limits are not always proportional as was the case in appendix B to §§ 20.1-20.601.

The air concentration values listed in Table 2, Column 1, were derived by one of two methods. For those radionuclides for which the stochastic limit is governing, the occupational stochastic inhalation ALI was divided by 2.4×10^3 , relating the inhalation ALI to the DAC, as explained above, and then divided by a factor of 300. The factor of 300 includes the following components: a factor of 50 to relate the 5-rem annual occupational dose limit to the 0.1-rem limit for members of the public, a factor of 3 to adjust for the difference in exposure time and the inhalation rate for a worker and that for members of the public; and a factor of 2 to adjust the occupational values (derived for adults) so that they are applicable to other age groups.

For those radionuclides for which submersion (external dose) is limiting, the occupational DAC in Table 1, Column 3, was divided by 219. The factor of 219 is composed of a factor of 50, as described above, and a factor of 4.38 relating occupational exposure for 2,000 hours per year to full-time exposure (8,760 hours per year). Note that an additional factor of 2 for age considerations is not warranted in the submersion case.

The water concentrations were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 1.3×10^3 . The factor of 7.3×10^3 (ml) includes the following components: the factors of 50 and 2 described above and a factor of 7.3×10^3 (ml) which is the annual water intake of "Reference Man."

Note 2 of this appendix provides groupings of radionuclides which are applicable to unknown mixtures of radionuclides. These groupings (including occupational inhalation ALIs and DACs, air and water effluent concentrations and sewerage) require demonstrating that the most limiting radionuclides in successive classes are absent. The limit for the unknown mixture is defined when the presence of the one of the listed radionuclides cannot be definitely excluded as being present either from knowledge of the radionuclide composition of the source or from actual measurements.

Table 3 "Sewer Disposal"

The monthly average concentrations for release to sanitary sewers are applicable to the provisions in § 20.2003. The concentration values were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3×10^3 (ml). The factor of 7.3×10^3 (ml) is composed of a factor of 7.3×10^3 (ml), the annual water intake by "Reference Man," and a factor of 10, such that the concentrations, if the sewage released by the licensee were the only source of water ingested by a reference man during a year, would result in a committed effective dose equivalent of 0.5 rem.

LIST OF ELEMENTS

Name	Atomic	
	Symbol	No.
Actinium.....	Ac	89
Aluminum.....	Al	13
Americium.....	Am	95
Antimony.....	Sb	51
Argon.....	Ar	18
Arsenic.....	As	33
Astatine.....	At	85
Barium.....	Ba	56
Berkelium.....	Bk	97
Beryllium.....	Be	4
Bismuth.....	Bi	83
Bromine.....	Br	35
Cadmium.....	Cd	48
Calcium.....	Ca	20
Californium.....	Cf	98
Carbon.....	C	6
Cerium.....	Ce	58
Cesium.....	Cs	55
Chlorine.....	Cl	17
Chromium.....	Cr	24
Cobalt.....	Co	27
Copper.....	Cu	29
Curium.....	Cm	96
Dysprosium.....	Dy	66
Einsteinium.....	Es	99
Erbium.....	Er	68
Europium.....	Eu	63
Fermium.....	Fm	100
Fluorine.....	F	9
Francium.....	Fr	87
Gadolinium.....	Gd	64
Gallium.....	Ga	31
Germanium.....	Ge	32

LIST OF ELEMENTS—Continued

Name	Atomic	
	Symbol	No.
Gold	Au	79
Hafnium	Hf	72
Holmium	Ho	67
Hydrogen	H	1
Indium	In	49
Iodine	I	53
Iridium	Ir	77
Iron	Fe	26
Krypton	Kr	36
Lanthanum	La	57
Lead	Pb	82
Lutetium	Lu	71
Magnesium	Mg	12
Manganese	Mn	25
Mendelevium	Md	101
Mercury	Hg	80
Molybdenum	Mo	42
Neodymium	Nd	60
Neptunium	Np	93
Nickel	Ni	28
Niobium	Nb	41
Osmium	Os	76
Palladium	Pd	46
Phosphorus	P	15
Platinum	Pt	78
Plutonium	Pu	94
Polonium	Po	84
Potassium	K	19
Praseodymium	Pr	59
Promethium	Pm	61
Protactinium	Pa	91

LIST OF ELEMENTS—Continued

Name	Atomic	
	Symbol	No.
Radium	Ra	88
Radon	Rn	86
Rhenium	Re	75
Rhodium	Rh	45
Rubidium	Rb	37
Ruthenium	Ru	44
Samarium	Sm	62
Scandium	Sc	21
Selenium	Se	34
Silicon	Si	14
Silver	Ag	47
Sodium	Na	11
Strontium	Sr	38
Sulfur	S	16
Tantalum	Ta	73
Technetium	Tc	43
Tellurium	Te	52
Terbium	Tb	65
Thallium	Tl	81
Thorium	Th	90
Thalium	Tm	69
Tin	Sn	50
Titanium	Ti	22
Tungsten	W	74
Uranium	U	92
Vanadium	V	23
Xenon	Xe	54
Ytterbium	Yb	70
Yttrium	Y	39
Zinc	Zn	30
Zirconium	Zr	40

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Inhalation		Air (μ Ci/ml)	Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
				ALI (μ Ci)	DAE (μ Ci/ml)			
1	Hydrogen-3	Water, DAE (includes skin absorption) Gas (MT or T ₂) Submersion ¹ : Use above values as MT and T ₂ oxidize in air and in the body to MTO	BE-4	BE-4	2E-5	1E-7	1E-3	1E-2
4	Beryllium-7	W, all compounds except those given for Y Y, oxides, halides, and nitrates	4E-4	2E-4	9E-6	3E-8	6E-4	6E-3
4	Beryllium-10	W, see ⁷ Be Y, see ⁷ Be	1E-3 (LLI wall (1E-3))	2E-2 1E-1	6E-8 6E-9	2E-10 2E-11	- 2E-5	- 2E-4
6	Carbon-11 ²	Monoxide Dioxide Compounds	- - 4E-5	1E-6 6E-5 4E-5	5E-4 3E-4 2E-4	2E-6 9E-7 6E-7	- - 6E-3	- - 6E-2
6	Carbon-14	Monoxide Dioxide Compounds	- - 2E-3	2E-6 2E-5 2E-3	7E-4 9E-5 1E-6	2E-6 3E-7 3E-9	- - 3E-5	- - 3E-4
9	Fluorine-18 ²	D, Fluorides of H, Li, Na, K, Rb, Cs, and Fr W, fluorides of Ba, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, As, Sb, Bi, Fe, Ru, Os, Co, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, V, Nb, Ta, Mn, Tc, and Re Y, Lanthanum fluoride	5E-4 5E-4 (5E-4)	7E-4 -	3E-5 -	1E-7 -	- 7E-4	- 7E-3
11	Sodium-22	D, all compounds	4E-2	6E-2	3E-7	9E-10	6E-6	6E-5
11	Sodium-24	D, all compounds	4E-3	5E-3	2E-6	7E-9	5E-5	5E-4
12	Magnesium-28	D, all compounds except those given for W W, oxides, hydroxides, carbides, halides, and nitrates	7E-2	2E-3	7E-7	2E-9	9E-6	9E-5
13	Aluminum-26	D, all compounds except those given for W W, oxides, hydroxides, carbides, halides, and nitrates	4E-2	6E-3	3E-8	9E-11	6E-6	6E-5

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases Sources
			Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)	Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
14	Silicon-31	D, all compounds except those given for W and Y	$9\text{E}+3$	$3\text{E}+4$	$1\text{E}+5$	$4\text{E}+8$	$1\text{E}+4$	$1\text{E}+3$
		W, oxides, hydroxides, carbides, and nitrates	-	$3\text{E}+4$	$1\text{E}+5$	$5\text{E}+8$	-	-
		Y, aluminosilicate glass	-	$3\text{E}+4$	$1\text{E}+5$	$4\text{E}+8$	-	-
14	Silicon-32	D, see ^{31}Si	$2\text{E}+3$ LLI wall ($3\text{E}+3$)	$2\text{E}+2$	$1\text{E}+7$	$3\text{E}+10$	-	-
		W, see ^{31}Si	-	$1\text{E}+2$	$5\text{E}+8$	$2\text{E}+10$	$4\text{E}+5$	$4\text{E}+4$
		Y, see ^{31}Si	-	$5\text{E}+0$	$2\text{E}+9$	$7\text{E}+12$	-	-
15	Phosphorus-32	D, all compounds except phosphates given for W	$6\text{E}+2$	$9\text{E}+2$	$4\text{E}+7$	$1\text{E}+9$	$9\text{E}+6$	$9\text{E}+5$
		W, phosphates of Zn^{2+} , S^{3+} , Mg^{2+} , Fe^{3+} , Bi^{3+} , and lanthanides	-	$4\text{E}+2$	$2\text{E}+7$	$5\text{E}+10$	-	-
		D, see ^{32}P	$6\text{E}+3$	$8\text{E}+3$	$4\text{E}+6$	$1\text{E}+8$	$8\text{E}+5$	$8\text{E}+4$
16	Sulfur-35	W, see ^{32}P	-	$3\text{E}+3$	$1\text{E}+6$	$4\text{E}+9$	-	-
		Vapor	-	$1\text{E}+4$	$6\text{E}+6$	$2\text{E}+8$	-	-
		D, sulfides and sulfates except those given for W	$1\text{E}+4$ LLI wall ($8\text{E}+3$)	$2\text{E}+4$	$7\text{E}+6$	$2\text{E}+8$	-	-
17	Chlorine-36	W, elemental sulfur, sulfides of Sr, Ba, Ge, Sn, Pb, As, Sb, Bi, Cu, Ag, Au, Zn, Cd, Hg, W, and Mo. Sulfates of Ca, Sr, Ba, Ra, As, Sb, and Bi	$6\text{E}+3$	-	-	-	$1\text{E}+4$	$1\text{E}+3$
		D, chlorides of H, Li, Na, K, Rb, Cs, and Fr	$2\text{E}+3$	$2\text{E}+1$	$1\text{E}+6$	$3\text{E}+9$	$2\text{E}+5$	$2\text{E}+4$
		W, chlorides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Co, Se, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, and Re	-	$2\text{E}+2$	$1\text{E}+7$	$3\text{E}+10$	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Cl)	Inhalation		Col. 1 Air (μ Cl/ml)	Col. 2 Water (μ Cl/ml)	Monthly Average Concentration (μ Cl/ml)
				Col. 2 ALI (μ Cl)	Col. 3 DAC (μ Cl/ml)			
17	Chlorine-36 ²	D, see ³⁶ Cl	2E+4 St. wall (3E+4)	4E+4	2E-5	6E-8	-	-
		W, see ³⁶ Cl	-	5E+4	2E-5	6E-8	3E-4	3E-3
17	Chlorine-39 ²	D, see ³⁶ Cl	2E+4 St. wall (4E+4)	5E+4	2E-5	7E-8	-	-
		W, see ³⁶ Cl	-	6E+4	2E-5	8E-8	5E-4	5E-3
18	Argon-37	Submersion ¹	-	-	1E+0	6E-3	-	-
18	Argon-39	Submersion ¹	-	-	2E-4	8E-7	-	-
18	Argon-41	Submersion ¹	-	-	3E-6	1E-8	-	-
19	Potassium-40	D, all compounds	2E+2	4E+2	2E-7	6E-10	4E-6	4E-5
19	Potassium-42	D, all compounds	5E+3	5E+3	2E-6	7E-9	6E-5	6E-4
19	Potassium-43	D, all compounds	6E+3	9E+3	4E-6	1E-8	9E-5	9E-4
19	Potassium-44 ²	D, all compounds	2E+4 St. wall (4E+4)	7E+4	3E-5	9E-8	-	-
			-	-	-	5E-4	5E-3	
19	Potassium-45 ²	D, all compounds	3E+4 St. wall (5E+4)	1E+5	5E-5	2E-7	-	-
			-	-	-	7E-4	7E-3	
20	Calcium-41	W, all compounds	3E+3 Bone surf (4E+3)	4E+3 Bone surf (4E+3)	2E-6	-	-	-
			-	-	-	5E-9	6E-5	6E-4
20	Calcium-45	W, all compounds	2E+3	8E+2	4E-7	1E-9	2E-5	2E-4
20	Calcium-47	W, all compounds	8E+2	9E+2	4E-7	1E-9	1E-5	1E-4
21	Scandium-43	Y, all compounds	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
21	Scandium-44a	Y, all compounds	5E+2	7E+2	3E-7	1E-9	7E-6	7E-5
21	Scandium-44	Y, all compounds	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
21	Scandium-46	Y, all compounds	9E+2	2E+2	1E-7	3E-10	1E-5	1E-4
21	Scandium-47	Y, all compounds	2E+3 LLI wall (3E+3)	3E+3	1E-6	4E-9	-	-
			-	-	-	4E-5	4E-4	
21	Scandium-48	Y, all compounds	8E+2	1E+3	6E-7	2E-9	1E-5	1E-4
21	Scandium-49 ²	Y, all compounds	2E+4	5E+4	2E-5	8E-8	3E-4	3E-3
22	Titanium-44	D, all compounds except those given for W and Y	3E+2	1E+1	5E-9	2E-11	4E-6	4E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	-	3E+1	1E-8	4E-11	-	-
		Y, SrTiO ₃	-	6E+0	2E-9	8E-12	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{m}^3$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{m}^3$)
				Col. 2 ALI (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{m}^3$)			
22	Titanium-45	D, see ^{44}Ti W, see ^{44}Ti Y, see ^{44}Ti	$9\text{E}+3$ - -	$3\text{E}+4$ $4\text{E}+4$ $3\text{E}+4$	$1\text{E}-5$ $1\text{E}-5$ $1\text{E}-5$	$3\text{E}-8$ $5\text{E}-8$ $4\text{E}-8$	$1\text{E}-4$ - -	$1\text{E}-3$ - -
23	Vanadium-47 ²	D, all compounds except those given for W	$3\text{E}+4$ St. wall ($3\text{E}+4$)	$8\text{E}+4$ -	$3\text{E}-5$ -	$1\text{E}-7$ -	- $4\text{E}-4$	- $4\text{E}-3$
		W, oxides, hydroxides, carbides, and halides	-	$1\text{E}+5$	$4\text{E}-5$	$1\text{E}-7$	-	-
23	Vanadium-48	D, see ^{47}V W, see ^{47}V	$6\text{E}+2$ -	$1\text{E}+3$ $6\text{E}+2$	$5\text{E}-7$ $3\text{E}-7$	$2\text{E}-9$ $9\text{E}-10$	$9\text{E}-6$ -	$9\text{E}-5$ -
23	Vanadium-49	D, see ^{47}V W, see ^{47}V	$7\text{E}+4$ LI wall ($9\text{E}+4$) -	$3\text{E}+4$ Bone surf ($3\text{E}+4$) $2\text{E}+4$	$1\text{E}-5$ - $8\text{E}-6$	- $5\text{E}-8$ $2\text{E}-8$	- $1\text{E}-3$ -	- $1\text{E}-2$ -
24	Chromium-48	D, all compounds except those given for W and Y	$6\text{E}+3$	$1\text{E}+4$	$5\text{E}-6$	$2\text{E}-8$	$8\text{E}-5$	$8\text{E}-4$
		W, halides and nitrates	-	$7\text{E}+3$	$3\text{E}-6$	$1\text{E}-8$	-	-
		Y, oxides and hydroxides	-	$7\text{E}+3$	$3\text{E}-6$	$1\text{E}-8$	-	-
24	Chromium-49 ²	D, see ^{48}Cr W, see ^{48}Cr Y, see ^{48}Cr	$3\text{E}+4$ - -	$8\text{E}+4$ $1\text{E}+5$ $9\text{E}+4$	$4\text{E}-5$ $4\text{E}-5$ $4\text{E}-5$	$1\text{E}-7$ $1\text{E}-7$ $1\text{E}-7$	$4\text{E}-4$ - -	$4\text{E}-3$ - -
24	Chromium-51	D, see ^{48}Cr W, see ^{48}Cr Y, see ^{48}Cr	$4\text{E}+4$ - -	$5\text{E}+4$ $2\text{E}+4$ $2\text{E}+4$	$2\text{E}-5$ $1\text{E}-5$ $8\text{E}-6$	$6\text{E}-8$ $3\text{E}-8$ $3\text{E}-8$	$5\text{E}-4$ - -	$5\text{E}-3$ - -
25	Manganese-51 ²	D, all compounds except those given for W	$2\text{E}+4$	$5\text{E}+4$	$2\text{E}-5$	$7\text{E}-8$	$3\text{E}-4$	$3\text{E}-3$
		W, oxides, hydroxides, halides, and nitrates	-	$6\text{E}+4$	$3\text{E}-5$	$8\text{E}-8$	-	-
25	Manganese-52 ²	D, see ^{51}Mn W, see ^{51}Mn	$3\text{E}+4$ St. wall ($4\text{E}+4$) -	$9\text{E}+4$ - $1\text{E}+5$	$4\text{E}-5$ - $4\text{E}-5$	$1\text{E}-7$ - $1\text{E}-7$	- $5\text{E}-4$ -	- $5\text{E}-3$ -
25	Manganese-52	D, see ^{51}Mn W, see ^{51}Mn	$7\text{E}+2$ -	$1\text{E}+3$ $9\text{E}+2$	$5\text{E}-7$ $4\text{E}-7$	$2\text{E}-9$ $1\text{E}-9$	$1\text{E}-5$ -	$1\text{E}-4$ -
25	Manganese-53	D, see ^{51}Mn W, see ^{51}Mn	$5\text{E}+4$ - -	$1\text{E}+4$ Bone surf ($2\text{E}+4$) $1\text{E}+4$	$5\text{E}-6$ - $5\text{E}-6$	- $3\text{E}-8$ $2\text{E}-8$	$7\text{E}-4$ - -	$7\text{E}-3$ - -
25	Manganese-54	D, see ^{51}Mn W, see ^{51}Mn	$2\text{E}+3$ -	$9\text{E}+2$ $8\text{E}+2$	$4\text{E}-7$ $3\text{E}-7$	$1\text{E}-9$ $1\text{E}-9$	$3\text{E}-5$ -	$3\text{E}-4$ -
25	Manganese-56	D, see ^{51}Mn W, see ^{51}Mn	$5\text{E}+3$ -	$2\text{E}+4$ $2\text{E}+4$	$6\text{E}-6$ $9\text{E}-6$	$2\text{E}-8$ $3\text{E}-8$	$7\text{E}-5$ -	$7\text{E}-4$ -

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table Releas. Seve
			Col. 1 Dose Ingestion ALI (μ Ci)	Inhalation		Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Month Average Concen. (μ Ci/a)
				Col. 2 ALI (μ Ci)	Col. 3 DAC (μ Ci/ml)			
26	Iron-52	D, all compounds except those given for W	9E+2	3E+3	1E-6	4E-9	1E-5	1E-4
		W, oxides, hydroxides, and halides	-	2E+3	1E-6	3E-9	-	-
26	Iron-55	D, see ^{55}Fe	9E+3	2E+3	8E-7	3E-9	1E-4	1E-3
		W, see ^{55}Fe	-	4E+3	2E-6	6E-9	-	-
26	Iron-59	D, see ^{59}Fe	8E+2	3E+2	1E-7	5E-10	1E-5	1E-4
		W, see ^{59}Fe	-	5E+2	2E-7	7E-10	-	-
26	Iron-60	D, see ^{60}Fe	3E+1	6E+0	3E-9	9E-12	4E-7	4E-6
		W, see ^{60}Fe	-	2E+1	8E-9	3E-11	-	-
27	Cobalt-55	W, all compounds except those given for Y	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, oxides, hydroxides, halides, and nitrates	-	3E+3	1E-6	4E-9	-	-
27	Cobalt-56	W, see ^{56}Co	5E+2	3E+2	1E-7	4E-10	6E-6	6E-5
		Y, see ^{56}Co	4E+2	2E+2	8E-8	3E-10	-	-
27	Cobalt-57	W, see ^{57}Co	8E+3	3E+3	1E-6	4E-9	6E-5	6E-4
		Y, see ^{57}Co	4E+3	7E+2	3E-7	9E-10	-	-
27	Cobalt-58m	W, see ^{58}Co	6E+4	9E+4	4E-5	1E-7	8E-4	8E-3
		Y, see ^{58}Co	-	6E+4	3E-5	9E-8	-	-
27	Cobalt-58	W, see ^{58}Co	2E+3	1E+3	5E-7	2E-9	2E-5	2E-4
		Y, see ^{58}Co	1E+3	7E+2	3E-7	1E-9	-	-
27	Cobalt-60m ²	W, see ^{60}Co	1E-6	4E-6	2E-3	6E-6	-	-
		St. wall	(1E-6)	-	-	-	-	-
		Y, see ^{60}Co	-	3E-6	1E-3	4E-6	2E-2	2E-1
27	Cobalt-60	W, see ^{60}Co	5E+2	2E+2	7E-8	2E-10	3E-6	3E-5
		Y, see ^{60}Co	2E+2	3E+1	1E-8	5E-11	-	-
27	Cobalt-61 ²	W, see ^{61}Co	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		Y, see ^{61}Co	2E+4	6E+4	2E-5	8E-8	-	-
27	Cobalt-62m ²	W, see ^{62}Co	4E+4	2E+5	7E-5	2E-7	-	-
		St. wall	(5E+4)	-	-	-	-	-
		Y, see ^{62}Co	-	2E+5	6E-5	2E-7	7E-4	7E-3
28	Nickel-56	D, all compounds except those given for W	1E+3	2E+3	8E-7	3E-9	2E-5	2E-4
		W, oxides, hydroxides, and carbides	-	1E+3	5E-7	2E-9	-	-
		Vapor	-	1E+3	5E-7	2E-9	-	-
28	Nickel-57	D, see ^{57}Ni	2E+3	5E+3	2E-6	7E-9	2E-5	2E-4
		W, see ^{57}Ni	-	3E+3	1E-6	4E-9	-	-
		Vapor	-	6E+3	3E-6	9E-9	-	-

Isotopic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{m}^3$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 ALI (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
3	Nickel-59	D, see ^{59}Ni	$2\text{E}+4$	$4\text{E}+3$	$2\text{E}-6$	$5\text{E}-9$	$3\text{E}-4$	$3\text{E}-3$
		W, see ^{59}Ni	-	$7\text{E}+3$	$3\text{E}-6$	$1\text{E}-8$	-	-
		Vapor	-	$2\text{E}+3$	$8\text{E}-7$	$3\text{E}-9$	-	-
1	Nickel-63	D, see ^{63}Ni	$9\text{E}+3$	$2\text{E}+3$	$7\text{E}-7$	$2\text{E}-9$	$1\text{E}-4$	$1\text{E}-3$
		W, see ^{63}Ni	-	$3\text{E}+3$	$1\text{E}-6$	$4\text{E}-9$	-	-
		Vapor	-	$8\text{E}+2$	$3\text{E}-7$	$1\text{E}-9$	-	-
1	Nickel-65	D, see ^{65}Ni	$8\text{E}+3$	$2\text{E}+4$	$1\text{E}-5$	$3\text{E}-8$	$1\text{E}-4$	$1\text{E}-3$
		W, see ^{65}Ni	-	$3\text{E}+4$	$1\text{E}-5$	$4\text{E}-8$	-	-
		Vapor	-	$2\text{E}+4$	$7\text{E}-6$	$2\text{E}-8$	-	-
1	Nickel-66	D, see ^{66}Ni	$4\text{E}+2$	$2\text{E}+3$	$7\text{E}-7$	$2\text{E}-9$	-	-
		LLI wall	($5\text{E}+2$)	-	-	-	$6\text{E}-6$	$6\text{E}-5$
		W, see ^{66}Ni	-	$6\text{E}+2$	$3\text{E}-7$	$9\text{E}-10$	-	-
	Copper-60 ²	Vapor	-	$3\text{E}+3$	$1\text{E}-6$	$4\text{E}-9$	-	-
		D, all compounds except those given for W and Y	$3\text{E}+4$	$9\text{E}+4$	$4\text{E}-5$	$1\text{E}-7$	-	-
		St. wall	($3\text{E}+4$)	-	-	-	$4\text{E}-4$	$4\text{E}-3$
	Copper-61	W, sulfides, halides, and nitrates	-	$1\text{E}+5$	$5\text{E}-5$	$2\text{E}-7$	-	-
		Y, oxides and hydroxides	-	$1\text{E}+5$	$4\text{E}-5$	$1\text{E}-7$	-	-
		D, see ^{60}Cu	$1\text{E}+4$	$3\text{E}+4$	$1\text{E}-5$	$4\text{E}-8$	$2\text{E}-4$	$2\text{E}-3$
	Copper-64	W, see ^{60}Cu	-	$4\text{E}+4$	$2\text{E}-5$	$6\text{E}-8$	-	-
		Y, see ^{60}Cu	-	$4\text{E}+4$	$1\text{E}-5$	$5\text{E}-8$	-	-
		D, see ^{60}Cu	$1\text{E}+4$	$3\text{E}+4$	$1\text{E}-5$	$4\text{E}-8$	$2\text{E}-4$	$2\text{E}-3$
	Copper-67	W, see ^{60}Cu	-	$2\text{E}+4$	$1\text{E}-5$	$3\text{E}-8$	-	-
		Y, see ^{60}Cu	-	$2\text{E}+4$	$9\text{E}-6$	$3\text{E}-8$	-	-
		D, see ^{60}Cu	$5\text{E}+3$	$8\text{E}+3$	$3\text{E}-6$	$1\text{E}-8$	$6\text{E}-5$	$6\text{E}-4$
	Zinc-62	W, see ^{60}Cu	-	$5\text{E}+3$	$2\text{E}-6$	$7\text{E}-9$	-	-
		Y, see ^{60}Cu	-	$5\text{E}+3$	$2\text{E}-6$	$6\text{E}-9$	-	-
		D, all compounds	$1\text{E}+3$	$3\text{E}+3$	$1\text{E}-6$	$4\text{E}-9$	$2\text{E}-5$	$2\text{E}-4$
	Zinc-63 ²	Y, all compounds	$2\text{E}+4$	$7\text{E}+4$	$3\text{E}-5$	$9\text{E}-8$	-	-
		St. wall	($3\text{E}+4$)	-	-	-	$3\text{E}-4$	$3\text{E}-3$
		D, all compounds	$4\text{E}+2$	$3\text{E}+2$	$1\text{E}-7$	$4\text{E}-10$	$5\text{E}-6$	$5\text{E}-5$
	Zinc-69m	Y, all compounds	$4\text{E}+3$	$7\text{E}+3$	$3\text{E}-6$	$1\text{E}-8$	$6\text{E}-5$	$6\text{E}-4$
		D, all compounds	$6\text{E}+4$	$1\text{E}+5$	$6\text{E}-5$	$2\text{E}-7$	$8\text{E}-4$	$8\text{E}-3$
		Y, all compounds	$6\text{E}+3$	$2\text{E}+4$	$7\text{E}-6$	$2\text{E}-8$	$8\text{E}-5$	$8\text{E}-4$
	Zinc-72m	Y, all compounds	$1\text{E}+3$	$1\text{E}+3$	$5\text{E}-7$	$2\text{E}-9$	$1\text{E}-5$	$1\text{E}-4$
		D, all compounds except those given for W	$5\text{E}+4$	$2\text{E}+5$	$7\text{E}-5$	$2\text{E}-7$	-	-
		St. wall	($6\text{E}+4$)	-	-	-	$9\text{E}-4$	$9\text{E}-3$
	Gallium-65 ²	W, oxides, hydroxides, carbides, halides, and nitrates	-	$2\text{E}+5$	$8\text{E}-5$	$3\text{E}-7$	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Cl)	Col. 2 ALI (μ Cl)	Col. 3 DAC (μ Cl/ml)	Col. 1 Air (μ Cl/ml)	Col. 2 Water (μ Cl/ml)	Monthly Average Concentration (μ Cl/ml)
31	Gallium-66	D, see ^{65}Ga W, see ^{65}Ga	1E+3 -	4E+3 3E+3	1E-6 1E-6	5E-9 4E-9	1E-5 -	1E-4 -
31	Gallium-67	D, see ^{65}Ga W, see ^{65}Ga	7E+3 -	1E+4 1E+4	6E-6 4E-6	2E-8 1E-8	1E-4 -	1E-3 -
31	Gallium-68 ²	D, see ^{65}Ga W, see ^{65}Ga	2E+4 -	4E+4 5E+4	2E-5 2E-5	6E-8 7E-8	2E-4 -	2E-3 -
31	Gallium-70 ²	D, see ^{65}Ga	5E+4 St. wall (7E+4)	2E+5 -	7E-5 -	2E-7 -	-	-
		W, see ^{65}Ga	-	2E+5	8E-5	3E-7	1E-3	1E-2
31	Gallium-72	D, see ^{65}Ga W, see ^{65}Ga	1E+3 -	4E+3 3E+3	1E-6 1E-6	5E-9 4E-9	2E-5 -	2E-4 -
31	Gallium-73	D, see ^{65}Ga W, see ^{65}Ga	5E+3 -	2E+4 2E+4	6E-6 6E-6	2E-8 2E-8	7E-5 -	7E-4 -
32	Germanium-66	D, all compounds except those given for W W, oxides, sulfides, and halides	2E+4 -	3E+4 2E+4	1E-5 8E-6	4E-8 3E-8	3E-4 -	3E-3 -
32	Germanium-67 ²	D, see ^{66}Ge	3E+4 St. wall (4E+4)	9E+4 -	4E-5 -	1E-7 -	-	-
		W, see ^{66}Ge	-	1E+5	4E-5	1E-7	6E-4	6E-3
32	Germanium-68	D, see ^{66}Ge W, see ^{66}Ge	5E+3 -	4E+3 1E+2	2E-6 4E-8	5E-9 1E-10	6E-5 -	6E-4 -
32	Germanium-69	D, see ^{66}Ge W, see ^{66}Ge	1E+4 -	2E+4 8E+3	6E-6 3E-6	2E-8 1E-8	2E-4 -	2E-3 -
32	Germanium-71	D, see ^{66}Ge W, see ^{66}Ge	5E+5 -	4E+5 4E+4	2E-4 2E-5	6E-7 6E-8	7E-3 -	7E-2 -
32	Germanium-75 ²	D, see ^{66}Ge	4E+4 St. wall (7E+4)	8E+4 -	3E-5 -	1E-7 -	-	-
		W, see ^{66}Ge	-	8E+4	4E-5	1E-7	9E-4	9E-3
32	Germanium-77	D, see ^{66}Ge W, see ^{66}Ge	9E+3 -	1E+4 6E+3	4E-6 2E-6	1E-8 8E-9	1E-4 -	1E-3 -
32	Germanium-78 ²	D, see ^{66}Ge	2E+4 St. wall (2E+4)	2E+4 -	9E-6 -	3E-8 -	-	-
		W, see ^{66}Ge	-	2E+4	9E-6	3E-8	3E-4	3E-3

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Col. 2	Col. 3 Inhalation DAC ($\mu\text{Ci}/\text{ml}$)	Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
33	Arsenic-69 ²	V, all compounds	3E+4 St. wall (4E+4)	1E+5	5E-5	2E-7	-	-
33	Arsenic-70 ²	V, all compounds	1E+4	5E+4	2E-5	7E-8	2E-4	2E-3
33	Arsenic-71	V, all compounds	4E+3	5E+3	2E-6	6E-9	5E-5	5E-4
33	Arsenic-72	V, all compounds	9E+2	1E+3	6E-7	2E-9	1E-5	1E-4
33	Arsenic-73	V, all compounds	8E+3	2E+3	7E-7	2E-9	1E-4	1E-3
33	Arsenic-74	V, all compounds	1E+3	8E+2	3E-7	1E-9	2E-5	2E-4
33	Arsenic-76	V, all compounds	1E+3	1E+3	6E-7	2E-9	1E-5	1E-4
33	Arsenic-77	V, all compounds	4E+3 LLI wall (5E+3)	5E+3	2E-6	7E-9	-	-
33	Arsenic-78 ²	V, all compounds	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
34	Selenium-70 ²	D, all compounds except those given for V	2E+4	4E+4	2E-5	5E-8	1E-4	1E-3
		V, oxides, hydroxides, carbides, and elemental Se	1E+4	4E+4	2E-5	6E-8	-	-
34	Selenium-73a ²	D, see ⁷⁰ Se	6E+4	2E+5	6E-5	2E-7	4E-4	4E-3
		V, see ⁷⁰ Se	3E+4	1E+5	6E-5	2E-7	-	-
34	Selenium-73	D, see ⁷⁰ Se	3E+3	1E+4	5E-6	2E-8	4E-5	4E-4
		V, see ⁷⁰ Se	-	2E+4	7E-6	2E-8	-	-
34	Selenium-75	D, see ⁷⁰ Se	5E+2	7E+2	3E-7	1E-9	7E-6	7E-5
		V, see ⁷⁰ Se	-	6E+2	3E-7	8E-10	-	-
34	Selenium-79	D, see ⁷⁰ Se	6E+2	8E+2	3E-7	1E-9	8E-6	8E-5
		V, see ⁷⁰ Se	-	6E+2	2E-7	8E-10	-	-
34	Selenium-81a ²	D, see ⁷⁰ Se	4E+4	7E+4	2E-5	9E-8	3E-4	3E-3
		V, see ⁷⁰ Se	2E+4	7E+4	3E-5	1E-7	-	-
34	Selenium-81 ²	D, see ⁷⁰ Se	6E+4 St. wall (8E+4)	2E+5	9E-5	3E-7	-	-
		V, see ⁷⁰ Se	-	2E+5	1E-4	3E-7	1E-3	1E-2
34	Selenium-83 ²	D, see ⁷⁰ Se	4E+4	1E+5	5E-5	2E-7	4E-4	4E-3
		V, see ⁷⁰ Se	3E+4	1E+5	5E-5	2E-7	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				ALI (μCi)	BAC ($\mu\text{Ci}/\text{ml}$)			
35	Bromine-74 ²	D, bromides of H, Li, Na, K, Rb, Cs, and Fr	1E+4 St. wall (2E+4)	4E+4	2E-5	5E-8	-	-
		V, bromides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Se, Y, Tl, Zr, Hf, V, Nb, Ta, Mn, Tc, and Re	-	4E+4	2E-5	6E-8	-	-
35	Bromine-74 ²	D, see 74 _{Br}	2E+4 St. wall (4E+4)	7E+4	3E-5	1E-7	-	-
		V, see 74 _{Br}	-	8E+4	4E-5	1E-7	5E-4	5E-3
35	Bromine-75 ²	D, see 74 _{Br}	3E+4 St. wall (4E+4)	5E+4	2E-5	7E-8	-	-
		V, see 74 _{Br}	-	5E+4	2E-5	7E-8	5E-4	5E-3
35	Bromine-76	D, see 74 _{Br}	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
		V, see 74 _{Br}	-	4E+3	2E-6	6E-9	-	-
35	Bromine-77	D, see 74 _{Br}	2E+4	2E+4	1E-5	3E-8	2E-4	2E-3
		V, see 74 _{Br}	-	2E+4	8E-6	3E-8	-	-
35	Bromine-80m	D, see 74 _{Br}	2E+4	2E+4	7E-6	2E-8	3E-4	3E-3
		V, see 74 _{Br}	-	1E+4	6E-6	2E-8	-	-
35	Bromine-80 ²	D, see 74 _{Br}	5E+4 St. wall (9E+4)	2E+5	8E-5	3E-7	-	-
		V, see 74 _{Br}	-	2E+5	9E-5	3E-7	1E-3	1E-2
35	Bromine-82	D, see 74 _{Br}	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
		V, see 74 _{Br}	-	4E+3	2E-6	5E-9	-	-
35	Bromine-83	D, see 74 _{Br}	5E+4 St. wall (7E+4)	6E+4	3E-5	9E-8	-	-
		V, see 74 _{Br}	-	6E+4	3E-5	9E-8	9E-4	9E-3
35	Bromine-84 ²	D, see 74 _{Br}	2E+4 St. wall (3E+4)	6E+4	2E-5	8E-8	-	-
		V, see 74 _{Br}	-	6E+4	3E-5	9E-8	4E-4	4E-3
36	Krypton-74 ²	Submersion ¹	-	-	3E-6	1E-8	-	-
36	Krypton-76	Submersion ¹	-	-	9E-6	4E-8	-	-
36	Krypton-77 ²	Submersion ¹	-	-	4E-6	2E-8	-	-
36	Krypton-79	Submersion ¹	-	-	2E-5	7E-8	-	-
36	Krypton-81	Submersion ¹	-	-	7E-4	3E-6	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases To Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 All (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
36	Krypton-83a ²	Submersion ¹			1E-2	5E-5	-	
36	Krypton-85a	Submersion ¹	-	-	2E-5	1E-7	-	-
36	Krypton-85	Submersion ¹	-	-	1E-4	7E-7	-	-
36	Krypton-87 ²	Submersion ¹	-	-	3E-6	2E-8	-	-
36	Krypton-88	Submersion ¹	-	-	2E-6	9E-9	-	-
37	Rubidium-79 ²	D, all compounds	4E+4 St. wall (6E+4)	1E+5	5E-5	2E-7	-	-
37	Rubidium-81a ²	D, all compounds	2E+5 St. wall (3E+5)	3E+5	1E-4	5E-7	-	-
37	Rubidium-81	D, all compounds	4E+4	5E+4	2E-5	7E-8	5E-4	5E-3
37	Rubidium-82a	D, all compounds	1E+4	2E+4	7E-6	2E-8	2E-4	2E-3
37	Rubidium-83	D, all compounds	6E+2	1E+3	4E-7	1E-9	9E-6	9E-5
37	Rubidium-84	D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
37	Rubidium-86	D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
37	Rubidium-87	D, all compounds	1E+3	2E+3	6E-7	2E-9	1E-5	2E-4
37	Rubidium-88 ²	D, all compounds	2E+4 St. wall (3E+4)	6E+4	3E-5	9E-8	-	-
37	Rubidium-89 ²	D, all compounds	4E+4 St. wall (6E+4)	1E+5	6E-5	2E-7	-	-
38	Strontium-89 ²	D, all soluble compounds except SrTiO ₃ Y, all insoluble compounds and SrTiO ₃	4E+3	1E+4	5E-6	2E-8	6E-5	5E-4
38	Strontium-81 ²	D, see ⁸⁰ Sr Y, see ⁸⁰ Sr	3E+4 2E+4	8E+4 8E+4	3E-5 3E-5	1E-7 1E-7	3E-4	3E-3
38	Strontium-82	D, see ⁸⁰ Sr Y, see ⁸⁰ Sr	3E+2 LLI wall (2E+2)	4E+2	2E-7	6E-10	-	-
38	Strontium-83	D, see ⁸⁰ Sr Y, see ⁸⁰ Sr	3E+3 2E+3	7E+3 4E+3	3E-6 1E-6	1E-8 5E-9	3E-5	3E-4
38	Strontium-85a ²	D, see ⁸⁰ Sr Y, see ⁸⁰ Sr	2E+5	6E+5 8E+5	3E-4 4E-4	9E-7 1E-6	3E-3	3E-2
38	Strontium-85	D, see ⁸⁰ Sr Y, see ⁸⁰ Sr	3E+3	3E+3 2E+3	1E-6 6E-7	4E-9 2E-9	4E-5	4E-4
38	Strontium-87a	D, see ⁸⁰ Sr Y, see ⁸⁰ Sr	5E+4 4E+4	1E+5 2E+5	5E-5 6E-5	2E-7 2E-7	6E-4	6E-3

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Col. 2 Inhalation ALI (μ Ci)	Col. 3 DAC (μ Ci/ml)	Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
38	Strontium-89	D, see ^{89}Sr	6E+2 LLI wall (6E+2)	8E+2	4E-7	1E-9	-	-
		Y, see ^{89}Sr	5E+2	1E+2	6E-8	2E-10	8E-6	8E-5
38	Strontium-90	D, see ^{90}Sr	3E+1 Bone surf (4E+1)	2E+1 Bone surf (2E+1)	8E-9	-	-	-
		Y, see ^{90}Sr	-	4E+0	2E-9	3E-11 6E-12	5E-7	5E-6
38	Strontium-91	D, see ^{91}Sr	2E+3	6E+3	2E-6	8E-9	2E-5	2E-4
		Y, see ^{91}Sr	-	4E+3	1E-6	5E-9	-	-
38	Strontium-92	D, see ^{92}Sr	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see ^{92}Sr	-	7E+3	3E-6	9E-9	-	-
39	Yttrium-86a ²	W, all compounds except those given for Y	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
		Y, oxides and hydroxides	-	5E+4	2E-5	8E-8	-	-
39	Yttrium-86	W, see ^{86}Y	1E+3	3E+3	1E-6	6E-9	2E-5	2E-4
		Y, see ^{86}Y	-	3E+3	1E-6	5E-9	-	-
39	Yttrium-87	W, see ^{87}Y	2E+3	3E+3	1E-6	5E-9	3E-5	3E-4
		Y, see ^{87}Y	-	2E+3	1E-6	5E-9	-	-
39	Yttrium-88	W, see ^{88}Y	1E+3	3E+2	1E-7	3E-10	1E-5	1E-4
		Y, see ^{88}Y	-	2E+2	1E-7	3E-10	-	-
39	Yttrium-90a	W, see ^{90}Y	8E+3	1E+4	5E-6	2E-8	1E-4	1E-3
		Y, see ^{90}Y	-	1E+4	5E-6	2E-8	-	-
39	Yttrium-90	W, see ^{90}Y	4E+2 LLI wall (5E+2)	7E+2	3E-7	9E-10	-	-
		Y, see ^{90}Y	-	6E+2	3E-7	9E-10	7E-6	7E-5
39	Yttrium-91a ²	W, see ^{91}Y	1E+5	2E+5	1E-4	3E-7	2E-3	2E-2
		Y, see ^{91}Y	-	2E+5	7E-5	2E-7	-	-
39	Yttrium-91	W, see ^{91}Y	5E+2 LLI wall (6E+2)	2E+2	7E-8	2E-10	-	-
		Y, see ^{91}Y	-	1E+2	5E-8	2E-10	8E-6	8E-5
39	Yttrium-92	W, see ^{92}Y	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see ^{92}Y	-	8E+3	3E-6	1E-8	-	-
39	Yttrium-93	W, see ^{93}Y	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, see ^{93}Y	-	2E+3	1E-6	3E-9	-	-
39	Yttrium-94a ²	W, see ^{94}Y	2E+4 SL wall (3E+4)	8E+4	3E-5	1E-7	-	-
		Y, see ^{94}Y	-	8E+4	3E-5	1E-7	4E-4	4E-3
39	Yttrium-95a ²	W, see ^{95}Y	4E+4 SL wall (5E+4)	2E+5	6E-5	2E-7	-	-
		Y, see ^{95}Y	-	1E+5	6E-5	2E-7	7E-4	7E-3

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Col. 2	Col. 3	Col. 1	Col. 2	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
			Inhalation			Air ($\mu\text{Ci}/\text{ml}$)	Water ($\mu\text{Ci}/\text{ml}$)	
			ALL (μCi)	OC ($\mu\text{Ci}/\text{ml}$)	DC ($\mu\text{Ci}/\text{ml}$)			
40	Zirconium-86	D, all compounds except those given for W and Y	1E+3	4E+3	2E-6	6E-9	2E-5	2E-4
		W, oxides, hydroxides, halides, and nitrates	-	3E+3	1E-6	4E-9	-	-
		Y, carbide	-	2E+3	1E-6	3E-9	-	-
40	Zirconium-88	D, see ^{86}Zr	4E+3	2E+2	9E-8	3E-10	5E-5	5E-4
		W, see ^{86}Zr	-	5E+2	2E-7	7E-10	-	-
		Y, see ^{86}Zr	-	3E+2	1E-7	4E-10	-	-
40	Zirconium-89	D, see ^{86}Zr	2E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see ^{86}Zr	-	2E+3	1E-6	3E-9	-	-
		Y, see ^{86}Zr	-	2E+3	1E-6	3E-9	-	-
40	Zirconium-93	D, see ^{86}Zr	1E+3	6E+0	3E-9	-	-	-
		Bone surf	(3E+3)	(2E+1)	-	2E-11	4E-5	4E-4
		W, see ^{86}Zr	-	2E+1	1E-8	-	-	-
		Bone surf	-	(6E+1)	-	9E-11	-	-
		Y, see ^{86}Zr	-	6E+1	2E-8	-	-	-
		Bone surf	-	(7E+1)	-	9E-11	-	-
40	Zirconium-95	D, see ^{86}Zr	1E+3	1E+2	5E-8	-	2E-5	2E-4
		Bone surf	-	(3E+2)	-	4E-10	-	-
		W, see ^{86}Zr	-	4E+2	2E-7	5E-10	-	-
		Y, see ^{86}Zr	-	3E+2	1E-7	4E-10	-	-
40	Zirconium-97	D, see ^{86}Zr	6E+2	2E+3	6E-7	3E-9	9E-6	9E-5
		W, see ^{86}Zr	-	1E+3	6E-7	2E-9	-	-
		Y, see ^{86}Zr	-	1E+3	5E-7	2E-9	-	-
41	Niobium-85 ²	W, all compounds except those given for Y	5E+4	2E+5	9E-5	3E-7	-	-
		SL wall	(7E+4)	-	-	-	1E-3	1E-2
		Y, oxides and hydroxides	-	2E+5	9E-5	3E-7	-	-
41	Niobium-85m ² (66 min)	W, see ^{85}Nb	1E+4	4E+4	2E-5	6E-8	1E-4	1E-3
		Y, see ^{85}Nb	-	4E+4	2E-5	5E-8	-	-
41	Niobium-89 (122 min)	W, see ^{85}Nb	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		Y, see ^{85}Nb	-	2E+4	6E-6	2E-8	-	-
41	Niobium-90	W, see ^{85}Nb	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
		Y, see ^{85}Nb	-	2E+3	1E-6	3E-9	-	-
41	Niobium-93m	W, see ^{85}Nb	9E+3	2E+3	6E-7	2E-9	-	-
		LLI wall	(1E+4)	-	-	-	2E-4	2E-3
		Y, see ^{85}Nb	-	2E+2	7E-6	2E-10	-	-
41	Niobium-94	W, see ^{85}Nb	9E+2	2E+2	6E-8	3E-10	1E-5	1E-4
		Y, see ^{85}Nb	-	2E+1	6E-9	2E-11	-	-
41	Niobium-95m	W, see ^{85}Nb	2E+3	3E+3	1E-6	4E-9	-	-
		LLI wall	(2E+3)	-	-	-	3E-5	3E-4
		Y, see ^{85}Nb	-	2E+3	9E-7	3E-9	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Inhalation		Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
				Col. 2 ALL (μ Ci)	Col. 3 DAC (μ Ci/ml)			
41	Niobium-95	V, see ^{95}Nb Y, see ^{95}Nb	2E+3	1E+3 1E+3	5E-7 5E-7	2E-9 2E-9	3E-5	3E-4
41	Niobium-96	V, see ^{96}Nb Y, see ^{96}Nb	1E+3	3E+3 2E+3	1E-6 1E-6	4E-9 3E-9	2E-5	2E-4
41	Niobium-97 ²	V, see ^{97}Nb Y, see ^{97}Nb	2E+4	8E+4 7E+4	3E-5 3E-5	1E-7 1E-7	3E-4	3E-3
41	Niobium-98 ²	V, see ^{98}Nb Y, see ^{98}Nb	1E+4	5E+4 5E+4	2E-5 2E-5	8E-8 7E-8	2E-4	2E-3
42	Molybdenum-90	D, all compounds except those given for Y Y, oxides, hydroxides, and MoS_2	4E+3 2E+3	7E+3 5E+3	3E-6 2E-6	1E-8 6E-9	3E-5	3E-4
42	Molybdenum-93a	D, see ^{90}Mo Y, see ^{90}Mo	9E+3 4E+3	2E+4 1E+4	7E-6 6E-6	2E-8 2E-8	6E-5	6E-4
42	Molybdenum-93	D, see ^{93}Mo Y, see ^{90}Mo	4E+3 2E+4	5E+3 2E+2	2E-6 8E-8	8E-9 2E-10	5E-5	5E-4
42	Molybdenum-99	D, see ^{90}Mo Y, see ^{90}Mo	2E+3 (1E+3) 1E+3	3E+3 - 1E+3	1E-6 - 6E-7	4E-9 - 2E-9	- 2E-5	- 2E-4
42	Molybdenum-103 ²	D, see ^{90}Mo Y, see ^{90}Mo	4E+4 (5E+4) -	1E+5 - 1E+5	6E-5 - 6E-5	2E-7 - 2E-7	- 7E-4	- 7E-3
43	Technetium-93a ²	D, all compounds except those given for V V, oxides, hydroxides, halides, and nitrates	7E+4 -	2E+5 3E+5	6E-5 1E-4	2E-7 4E-7	1E-3	3E-2
43	Technetium-93	D, see ^{93m}Tc V, see ^{93m}Tc	3E+4 -	7E+4 1E+5	3E-5 4E-5	1E-7 1E-7	4E-4	4E-3
43	Technetium-94a ²	D, see ^{93m}Tc V, see ^{93m}Tc	2E+4 -	4E+4 6E+4	2E-5 2E-5	6E-8 8E-8	3E-4	3E-3
43	Technetium-94	D, see ^{93m}Tc V, see ^{93m}Tc	3E+3 -	2E+4 2E+4	8E-6 1E-5	3E-8 3E-8	1E-4	1E-3
43	Technetium-95a	D, see ^{93m}Tc V, see ^{93m}Tc	4E+3 -	5E+3 2E+3	2E-6 8E-7	8E-9 3E-9	5E-5	5E-4
43	Technetium-95	D, see ^{93m}Tc V, see ^{93m}Tc	1E+4 -	2E+4 2E+4	9E-6 8E-6	3E-8 3E-8	1E-4	1E-3
43	Technetium-96a ²	D, see ^{93m}Tc V, see ^{93m}Tc	2E+5 -	3E+5 2E+5	1E-4 1E-4	4E-7 3E-7	2E-3	2E-2
43	Technetium-96	D, see ^{93m}Tc V, see ^{93m}Tc	2E+3 -	3E+3 2E+3	1E-6 9E-7	5E-9 3E-9	3E-5	3E-4
43	Technetium-97a	D, see ^{93m}Tc V, see ^{93m}Tc	5E+3 -	7E+3 (7E+3) 1E+3	3E-6 - 5E-7	- 1E-8 2E-9	6E-5	6E-4

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Inhalation		Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
				Col. 2 ALL (μ Ci)	Col. 3 DAC (μ Ci/ml)			
43	Technetium-97	D, see ^{97m}Tc W, see ^{97m}Tc	4E+4 -	5E+4 6E+3	2E-5 2E-6	7E-8 8E-9	5E-4 -	5E-3 -
43	Technetium-98	D, see ^{98m}Tc W, see ^{98m}Tc	1E+3 -	2E+3 3E+2	7E-7 1E-7	2E-9 4E-10	1E-5 -	1E-4 -
43	Technetium-99a	D, see ^{99a}Tc W, see ^{99a}Tc	8E+4 -	2E+5 2E+5	6E-5 1E-4	2E-7 3E-7	1E-3 -	1E-2 -
43	Technetium-99	D, see ^{99a}Tc W, see ^{99a}Tc	4E+3 -	5E+3 (6E+3) 7E+2	2E-6 -	- 8E-9 9E-10	6E-5 -	6E-4 -
43	Technetium-101 ²	D, see ^{101m}Tc W, see ^{101m}Tc	9E+4 (1E+5) -	3E+5 4E+5	1E-4 2E-4	5E-7 5E-7	- 2E-3	- 2E-2
43	Technetium-104 ²	D, see ^{104m}Tc W, see ^{104m}Tc	2E+4 (3E+4) -	7E+4 9E+4	3E-5 4E-5	1E-7 1E-7	- 4E-4	- 4E-3
44	Ruthenium-94 ²	D, all compounds except those given for W and Y W, halides Y, oxides and hydroxides	2E+4 - -	4E+4 6E+4 6E+4	2E-5 3E-5 2E-5	6E-8 9E-8 8E-8	2E-4 -	2E-3 -
44	Ruthenium-97	D, see ^{94}Ru W, see ^{94}Ru Y, see ^{94}Ru	8E+3 - -	2E+4 1E+4 1E+4	8E-6 5E-6 5E-6	3E-8 2E-8 2E-8	1E-4 -	1E-3 -
44	Ruthenium-103	D, see ^{94}Ru W, see ^{94}Ru Y, see ^{94}Ru	2E+3 - -	2E+3 1E+3 6E+2	7E-7 4E-7 3E-7	2E-9 1E-9 9E-10	3E-5 -	3E-4 -
44	Ruthenium-105	D, see ^{94}Ru W, see ^{94}Ru Y, see ^{94}Ru	5E+3 - -	1E+4 1E+4 1E+4	6E-6 6E-6 5E-6	2E-8 2E-8 2E-8	7E-5 -	7E-4 -
44	Ruthenium-106	D, see ^{94}Ru W, see ^{94}Ru Y, see ^{94}Ru	2E+2 (2E+2) -	9E+1 5E+1 1E+1	4E-8 2E-8 5E-9	1E-10 8E-11 2E-11	- 3E-6 -	- 3E-5 -
45	Rhodium-99	D, all compounds except those given for W and Y W, halides Y, oxides and hydroxides	2E+4 - -	6E+4 8E+4 7E+4	2E-6 3E-5 3E-5	8E-8 1E-7 9E-8	2E-4 -	2E-3 -
45	Rhodium-99	D, see ^{99m}Rh W, see ^{99m}Rh Y, see ^{99m}Rh	2E+3 - -	3E+3 2E+3 2E+3	1E-6 9E-7 8E-7	4E-9 3E-9 3E-9	3E-5 -	3E-4 -

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Col. 2	Col. 3 Inhalation DAC (μ Ci/mi)	Col. 1 Air (μ Ci/mi)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
45	Rhodium-100	O, see ^{99m}Rh	$2\text{E}+3$	$5\text{E}+3$	$2\text{E}+6$	$7\text{E}+9$	$2\text{E}+5$	$2\text{E}+4$
		W, see ^{99m}Rh	-	$4\text{E}+3$	$2\text{E}+6$	$6\text{E}+9$	-	-
		Y, see ^{99m}Rh	-	$4\text{E}+3$	$2\text{E}+6$	$5\text{E}+9$	-	-
45	Rhodium-102m	O, see ^{99m}Rh	$6\text{E}+3$	$2\text{E}+4$	$5\text{E}+6$	$2\text{E}+8$	$8\text{E}+5$	$8\text{E}+4$
		W, see ^{99m}Rh	-	$8\text{E}+3$	$4\text{E}+6$	$1\text{E}+8$	-	-
		Y, see ^{99m}Rh	-	$8\text{E}+3$	$3\text{E}+6$	$1\text{E}+8$	-	-
45	Rhodium-101	O, see ^{99m}Rh	$2\text{E}+3$	$5\text{E}+2$	$2\text{E}+7$	$7\text{E}+10$	$3\text{E}+5$	$3\text{E}+4$
		W, see ^{99m}Rh	-	$8\text{E}+2$	$3\text{E}+7$	$3\text{E}+9$	-	-
		Y, see ^{99m}Rh	-	$2\text{E}+2$	$6\text{E}+6$	$2\text{E}+10$	-	-
45	Rhodium-102m	O, see ^{99m}Rh	$1\text{E}+3$	$5\text{E}+2$	$2\text{E}+7$	$7\text{E}+10$	-	-
		W, see ^{99m}Rh	(LLI wall ($3\text{E}+3$))	-	-	-	$2\text{E}+5$	$2\text{E}+4$
		Y, see ^{99m}Rh	-	$4\text{E}+2$	$2\text{E}+7$	$5\text{E}+10$	-	-
45	Rhodium-102	O, see ^{99m}Rh	$6\text{E}+2$	$9\text{E}+1$	$4\text{E}+8$	$1\text{E}+10$	$8\text{E}+6$	$8\text{E}+5$
		W, see ^{99m}Rh	-	$2\text{E}+2$	$3\text{E}+8$	$2\text{E}+10$	-	-
		Y, see ^{99m}Rh	-	$6\text{E}+1$	$2\text{E}+8$	$8\text{E}+11$	-	-
45	Rhodium-103m ²	O, see ^{99m}Rh	$4\text{E}+5$	$1\text{E}+6$	$5\text{E}+4$	$2\text{E}+8$	$6\text{E}+3$	$6\text{E}+2$
		W, see ^{99m}Rh	-	$1\text{E}+6$	$5\text{E}+4$	$2\text{E}+8$	-	-
		Y, see ^{99m}Rh	-	$1\text{E}+6$	$5\text{E}+4$	$2\text{E}+8$	-	-
45	Rhodium-105	O, see ^{99m}Rh	$4\text{E}+1$	$1\text{E}+4$	$5\text{E}+6$	$2\text{E}+8$	-	-
		W, see ^{99m}Rh	(LLI wall ($4\text{E}+3$))	-	-	-	$9\text{E}+5$	$9\text{E}+4$
		Y, see ^{99m}Rh	-	$6\text{E}+1$	$1\text{E}+6$	$9\text{E}+9$	-	-
45	Rhodium-106m	O, see ^{99m}Rh	$8\text{E}+3$	$3\text{E}+4$	$2\text{E}+5$	$4\text{E}+8$	$1\text{E}+4$	$1\text{E}+1$
		W, see ^{99m}Rh	-	$4\text{E}+4$	$2\text{E}+5$	$5\text{E}+8$	-	-
		Y, see ^{99m}Rh	-	$4\text{E}+4$	$2\text{E}+5$	$9\text{E}+8$	-	-
45	Rhodium-107 ²	O, see ^{99m}Rh	$2\text{E}+4$	$2\text{E}+5$	$2\text{E}+4$	$3\text{E}+7$	-	-
		W, see ^{99m}Rh	(SLI wall ($3\text{E}+5$))	-	-	-	$1\text{E}+3$	$1\text{E}+2$
		Y, see ^{99m}Rh	-	$3\text{E}+5$	$2\text{E}+4$	$4\text{E}+7$	-	-
46	Palladium-100	O, all compounds except those given for W and Y	$1\text{E}+3$	$1\text{E}+3$	$6\text{E}+7$	$2\text{E}+9$	$2\text{E}+5$	$2\text{E}+4$
		W, nitrates	-	$1\text{E}+3$	$9\text{E}+7$	$2\text{E}+9$	-	-
		Y, oxides and hydrides	-	$2\text{E}+3$	$6\text{E}+7$	$2\text{E}+9$	-	-
46	Palladium-101	O, see ^{100}Pd	$1\text{E}+4$	$3\text{E}+4$	$1\text{E}+5$	$5\text{E}+8$	$2\text{E}+4$	$2\text{E}+3$
		W, see ^{100}Pd	-	$3\text{E}+4$	$2\text{E}+5$	$9\text{E}+8$	-	-
		Y, see ^{100}Pd	-	$3\text{E}+4$	$1\text{E}+5$	$4\text{E}+8$	-	-
46	Palladium-101	O, see ^{100}Pd	$6\text{E}+3$	$6\text{E}+3$	$3\text{E}+6$	$9\text{E}+9$	-	-
		W, see ^{100}Pd	(LLI wall ($7\text{E}+3$))	-	-	-	$1\text{E}+4$	$2\text{E}+3$
		Y, see ^{100}Pd	-	$4\text{E}+3$	$2\text{E}+6$	$6\text{E}+9$	-	-
46	Palladium-107	O, see ^{100}Pd	$3\text{E}+4$	$2\text{E}+4$	$9\text{E}+6$	-	-	-
		W, see ^{100}Pd	(LLI wall ($4\text{E}+4$))	(2E+4) kidneys	-	$3\text{E}+8$	$5\text{E}+4$	$5\text{E}+3$
		Y, see ^{100}Pd	-	$7\text{E}+3$	$3\text{E}+6$	$1\text{E}+8$	-	-
			-	$4\text{E}+2$	$2\text{E}+7$	$6\text{E}+10$	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 1 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 ALI (μCi)	Col. 1 DAC ($\mu\text{Ci}/\text{ml}$)			
46	Palladium-109	D, see ^{100}Pd W, see ^{100}Pd Y, see ^{100}Pd	$2\text{E}+3$ - -	$6\text{E}+3$ $5\text{E}+3$ $5\text{E}+1$	$3\text{E}-6$ $2\text{E}-6$ $2\text{E}-6$	$9\text{E}-9$ $8\text{E}-9$ $6\text{E}-9$	$3\text{E}-5$ - -	$3\text{E}-4$ - -
47	Silver- ^{102}Ag	D, all compounds except those given for W and Y W, nitrates and sulfides Y, oxides and hydroxides	$5\text{E}+4$ St. wall ($6\text{E}+4$) - -	$2\text{E}+5$ - $2\text{E}+5$	$8\text{E}-6$ - $8\text{E}-5$	$2\text{E}-7$ - $3\text{E}-7$	- $9\text{E}-4$ -	- $9\text{E}-3$ -
47	Silver- ^{103}Ag	D, see ^{102}Ag W, see ^{102}Ag Y, see ^{102}Ag	$4\text{E}+4$ - -	$1\text{E}+5$ $1\text{E}+5$ $1\text{E}+5$	$4\text{E}-5$ $5\text{E}-5$ $5\text{E}-5$	$1\text{E}-7$ $2\text{E}-7$ $2\text{E}-7$	$5\text{E}-4$ - -	$5\text{E}-1$ - -
47	Silver- ^{104m}Ag	D, see ^{102}Ag W, see ^{102}Ag Y, see ^{102}Ag	$3\text{E}+4$ - -	$9\text{E}+4$ $1\text{E}+5$ $1\text{E}+5$	$4\text{E}-5$ $5\text{E}-5$ $5\text{E}-5$	$1\text{E}-7$ $2\text{E}-7$ $2\text{E}-7$	$4\text{E}-4$ - -	$4\text{E}-1$ - -
47	Silver- ^{104}Ag	D, see ^{102}Ag W, see ^{102}Ag Y, see ^{102}Ag	$2\text{E}+4$ - -	$7\text{E}+4$ $1\text{E}+5$ $1\text{E}+5$	$3\text{E}-5$ $6\text{E}-5$ $6\text{E}-5$	$1\text{E}-7$ $2\text{E}-7$ $2\text{E}-7$	$3\text{E}-4$ - -	$3\text{E}-3$ - -
47	Silver-105	D, see ^{102}Ag W, see ^{102}Ag Y, see ^{102}Ag	$3\text{E}+1$ - -	$1\text{E}+3$ $2\text{E}+1$ $2\text{E}+3$	$4\text{E}-7$ $7\text{E}-7$ $7\text{E}-7$	$1\text{E}-9$ $2\text{E}-9$ $2\text{E}-9$	$4\text{E}-5$ - -	$4\text{E}-4$ - -
47	Silver-106m	D, see ^{102}Ag W, see ^{102}Ag Y, see ^{102}Ag	$8\text{E}+2$ - -	$7\text{E}+2$ $9\text{E}+2$ $9\text{E}+2$	$3\text{E}-7$ $4\text{E}-7$ $4\text{E}-7$	$1\text{E}-9$ $1\text{E}-9$ $1\text{E}-9$	$1\text{E}-5$ - -	$1\text{E}-4$ - -
47	Silver- ^{106}Ag	D, see ^{102}Ag W, see ^{102}Ag Y, see ^{102}Ag	$6\text{E}+4$ St. wall ($6\text{E}+4$) - -	$2\text{E}+5$ - $2\text{E}+5$	$8\text{E}-5$ - $9\text{E}-5$	$3\text{E}-7$ - $3\text{E}-7$	- $9\text{E}-4$ -	- $9\text{E}-3$ -
47	Silver-108m	D, see ^{102}Ag W, see ^{102}Ag Y, see ^{102}Ag	$6\text{E}+2$ - -	$2\text{E}+2$ $3\text{E}+2$ $2\text{E}+1$	$8\text{E}-8$ $1\text{E}-7$ $1\text{E}-8$	$3\text{E}-10$ $4\text{E}-10$ $3\text{E}-11$	$9\text{E}-6$ - -	$9\text{E}-5$ - -
47	Silver-110m	D, see ^{102}Ag W, see ^{102}Ag Y, see ^{102}Ag	$5\text{E}+2$ - -	$1\text{E}+2$ $2\text{E}+2$ $9\text{E}+1$	$5\text{E}-8$ $8\text{E}-8$ $4\text{E}-8$	$2\text{E}-10$ $3\text{E}-10$ $1\text{E}-10$	$6\text{E}-6$ - -	$6\text{E}-5$ - -
47	Silver-111	D, see ^{102}Ag W, see ^{102}Ag Y, see ^{102}Ag	$9\text{E}+2$ St. wall ($1\text{E}+3$) -	$2\text{E}+3$ Liver ($7\text{E}+1$) $9\text{E}+2$	$6\text{E}-7$ - $4\text{E}-7$	- $2\text{E}-9$ $1\text{E}-9$	- $2\text{E}-5$ -	- $2\text{E}-4$ -
47	Silver-112	D, see ^{102}Ag W, see ^{102}Ag Y, see ^{102}Ag	$3\text{E}+3$ - -	$8\text{E}+1$ $1\text{E}+4$ $9\text{E}+1$	$3\text{E}-6$ $4\text{E}-6$ $4\text{E}-6$	$1\text{E}-8$ $1\text{E}-8$ $1\text{E}-8$	$4\text{E}-5$ - -	$4\text{E}-4$ - -

Atomic No.	Radioisotope	Class	Table 2 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				AI (μCi)	BE ($\mu\text{Ci}/\text{ml}$)			
47	Silver-115 ²	D, see ¹⁰² Ag	3E-4 SE, well (3E-4)	9E-4	4E-5	1E-7	-	-
		W, see ¹⁰² Ag	-	9E-4	4E-5	1E-7	4E-4	4E-3
		Y, see ¹⁰² Ag	-	8E-4	3E-5	1E-2	-	-
48	Cadmium-104 ²	D, all compounds except those given for W and Y	2E-4	7E-4	3E-5	9E-8	3E-4	3E-3
		W, sulfides, halides, and nitrates	-	1E-5	5E-5	2E-7	-	-
		Y, oxides and hydroxides	-	1E-5	5E-5	2E-7	-	-
48	Cadmium-107	D, see ¹⁰⁴ Cd	2E-4	5E-4	2E-5	8E-8	3E-4	3E-3
		W, see ¹⁰⁴ Cd	-	6E-4	2E-5	8E-8	-	-
		Y, see ¹⁰⁴ Cd	-	5E-4	2E-5	7E-8	-	-
48	Cadmium-109	D, see ¹⁰⁴ Cd	3E-2 Kidneys (4E-2)	4E-3 Kidneys (5E-3)	1E-6	-	-	-
		W, see ¹⁰⁴ Cd	-	3E-2 Kidneys	5E-8	7E-11	6E-6	6E-5
		Y, see ¹⁰⁴ Cd	-	(3E-2) 1E-2	5E-8	2E-10 2E-10	-	-
48	Cadmium-113a	D, see ¹⁰⁴ Cd	2E-1 Kidneys (4E-1)	2E-6 Kidneys (4E-6)	3E-9	-	-	-
		W, see ¹⁰⁴ Cd	-	8E-6 Kidneys	4E-9	5E-12	5E-7	5E-6
		Y, see ¹⁰⁴ Cd	-	(1E-1) 1E-1	5E-9	2E-11	-	-
48	Cadmium-113	D, see ¹⁰⁴ Cd	2E-1 Kidneys (3E-1)	2E-6 Kidneys (3E-6)	9E-10	-	-	-
		W, see ¹⁰⁴ Cd	-	8E-6 Kidneys	3E-9	5E-12	4E-7	4E-6
		Y, see ¹⁰⁴ Cd	-	(3E-1) 1E-1	5E-9	2E-11	-	-
48	Cadmium-113m	D, see ¹⁰⁴ Cd	3E-2	5E-1 Kidneys (8E-1)	2E-8	-	4E-6	4E-5
		W, see ¹⁰⁴ Cd	-	1E-2	5E-8	1E-10	-	-
		Y, see ¹⁰⁴ Cd	-	1E-2	6E-8	2E-10	-	-
48	Cadmium-115	D, see ¹⁰⁴ Cd	9E-2 (1.7E-1)	1E-3	6E-7	2E-9	-	-
		W, see ¹⁰⁴ Cd	-	1E-3	5E-7	2E-9	1E-5	1E-4
		Y, see ¹⁰⁴ Cd	-	1E-3	6E-7	2E-9	-	-
48	Cadmium-117a	D, see ¹⁰⁴ Cd	5E-3	1E-4	5E-6	2E-8	6E-5	6E-4
		W, see ¹⁰⁴ Cd	-	2E-4	7E-6	2E-8	-	-
		Y, see ¹⁰⁴ Cd	-	1E-4	6E-6	2E-8	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 ALL (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
48	Cadmium-117	D, see ^{104}Cd W, see ^{104}Cd T, see ^{104}Cd	5E+3 - -	1E+4 2E+4 1E+4	5E-6 7E-6 6E-6	2E-8 2E-8 2E-8	6E-5 - -	6E-4 - -
49	Indium-109	D, all compounds except those given for W W, oxides, hydrides, halides, and nitrates	2E+4 -	4E+4 6E+4	2E-5 3E-5	6E-8 9E-8	3E-4 -	3E-3 -
49	Indium-110 ² (69.1 min)	D, see ^{109}In W, see ^{109}In	2E+4 -	4E+4 6E+4	2E-5 2E-5	6E-8 8E-8	2E-4 -	2E-3 -
49	Indium-110 (4.9 h)	D, see ^{109}In W, see ^{109}In	5E+3 -	2E+4 2E+4	7E-6 8E-6	2E-8 3E-8	7E-5 -	7E-4 -
49	Indium-111	D, see ^{109}In W, see ^{109}In	4E+3 -	6E+3 6E+3	3E-6 3E-6	9E-9 9E-9	6E-5 -	6E-4 -
49	Indium-112 ²	D, see ^{109}In W, see ^{109}In	2E+5 -	6E+5 7E+5	3E-4 3E-4	9E-7 1E-6	2E-3 -	2E-2 -
49	Indium-113m ²	D, see ^{109}In W, see ^{109}In	5E+4 -	1E+5 2E+5	6E-5 8E-5	2E-7 3E-7	7E-4 -	7E-3 -
49	Indium-114a	D, see ^{109}In W, see ^{109}In	3E+2 LLI wall (4E+2) -	6E+1 -	3E-8 -	9E-11 1E-10	- 5E-6	- 5E-5
4	Indium-115a	D, see ^{109}In W, see ^{109}In	1E+4 -	4E+4 5E+4	2E-5 2E-5	6E-8 7E-8	2E-4 -	2E-3 -
49	Indium-115	D, see ^{109}In W, see ^{109}In	4E+1 -	1E+0 5E+0	6E-10 2E-9	2E-12 8E-12	5E-7 -	5E-6 -
49	Indium-116m ²	D, see ^{109}In W, see ^{109}In	2E+4 -	8E+4 1E+5	3E-5 5E-5	1E-7 2E-7	3E-4 -	3E-3 -
49	Indium-117m ²	D, see ^{109}In W, see ^{109}In	1E+4 -	3E+4 4E+4	1E-5 2E-5	5E-8 6E-8	2E-4 -	2E-3 -
49	Indium-117 ²	D, see ^{109}In W, see ^{109}In	6E+4 -	2E+5 2E+5	7E-5 9E-5	2E-7 3E-7	8E-4 -	8E-3 -
49	Indium-119m ²	D, see ^{109}In W, see ^{109}In	4E+4 SLI wall (5E+4) -	1E+5 -	5E-5 -	2E-7 -	- 7E-4	- 7E-3
50	Tin-110	D, all compounds except those given for W W, sulfides, oxides, hydrides, halides, nitrates, and stannic phosphate	4E+3 -	1E+4 1E+4	5E-6 5E-6	2E-8 2E-8	5E-5 -	5E-4 -
50	Tin-111 ²	D, see ^{110}Sn W, see ^{110}Sn	7E+4 -	2E+5 3E+5	9E-5 1E-4	3E-7 4E-7	1E-3 -	1E-2 -

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Col. 2 Inhalation ALI (μ Ci)	Col. 1 DAC (μ Ci/ml)	Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
50	Tin-113	D, see ^{110}Sn	$2\text{E}+3$ (LLI wall) ($2\text{E}+3$)	$1\text{E}+3$	$5\text{E}-7$	$2\text{E}-9$	-	-
		V, see ^{110}Sn	-	$5\text{E}+2$	$2\text{E}-7$	$8\text{E}-10$	$3\text{E}-5$	$3\text{E}-4$
50	Tin-117m	D, see ^{110}Sn	$2\text{E}+3$ (LLI wall) ($2\text{E}+3$)	$1\text{E}+1$ Bone surf. ($2\text{E}+3$)	$5\text{E}-7$	-	-	-
		V, see ^{110}Sn	-	$1\text{E}+3$	$6\text{E}-7$	$3\text{E}-9$ $2\text{E}-9$	$3\text{E}-5$	$3\text{E}-4$
50	Tin-119m	D, see ^{110}Sn	$3\text{E}+3$ (LLI wall) ($4\text{E}+3$)	$2\text{E}+3$	$1\text{E}-6$	$3\text{E}-9$	-	-
		V, see ^{110}Sn	-	$1\text{E}+3$	$4\text{E}-7$	$1\text{E}-9$	$6\text{E}-5$	$6\text{E}-4$
50	Tin-121m	D, see ^{110}Sn	$3\text{E}+3$ (LLI wall) ($4\text{E}+3$)	$9\text{E}+2$	$4\text{E}-7$	$1\text{E}-9$	-	-
		V, see ^{110}Sn	-	$5\text{E}+2$	$2\text{E}-7$	$8\text{E}-10$	$5\text{E}-5$	$5\text{E}-4$
50	Tin-121	D, see ^{110}Sn	$6\text{E}+3$ (LLI wall) ($6\text{E}+3$)	$2\text{E}+4$	$6\text{E}-6$	$2\text{E}-8$	-	-
		V, see ^{110}Sn	-	$1\text{E}+4$	$5\text{E}-6$	$2\text{E}-8$	$8\text{E}-5$	$8\text{E}-4$
50	Tin-123m ²	D, see ^{110}Sn	$5\text{E}+4$	$1\text{E}+5$	$5\text{E}-5$	$2\text{E}-7$	$7\text{E}-4$	$7\text{E}-3$
		V, see ^{110}Sn	-	$1\text{E}+5$	$6\text{E}-5$	$2\text{E}-7$	-	-
50	Tin-123	D, see ^{110}Sn	$5\text{E}+2$ (LLI wall) ($6\text{E}+2$)	$6\text{E}+2$	$3\text{E}-7$	$9\text{E}-10$	-	-
		V, see ^{110}Sn	-	$2\text{E}+2$	$7\text{E}-8$	$2\text{E}-10$	$9\text{E}-6$	$9\text{E}-5$
50	Tin-125	D, see ^{110}Sn	$4\text{E}+2$ (LLI wall) ($5\text{E}+2$)	$9\text{E}+2$	$4\text{E}-7$	$1\text{E}-9$	-	-
		V, see ^{110}Sn	-	$4\text{E}+2$	$1\text{E}-7$	$5\text{E}-10$	$6\text{E}-6$	$6\text{E}-5$
50	Tin-126	D, see ^{110}Sn	$3\text{E}+2$	$6\text{E}+1$	$2\text{E}-8$	$8\text{E}-11$	$4\text{E}-6$	$4\text{E}-5$
		V, see ^{110}Sn	-	$7\text{E}+1$	$3\text{E}-8$	$9\text{E}-11$	-	-
50	Tin-127	D, see ^{110}Sn	$7\text{E}+3$	$2\text{E}+4$	$8\text{E}-6$	$3\text{E}-8$	$9\text{E}-5$	$9\text{E}-4$
		V, see ^{110}Sn	-	$2\text{E}+4$	$8\text{E}-6$	$3\text{E}-8$	-	-
50	Tin-128 ²	D, see ^{110}Sn	$9\text{E}+3$	$3\text{E}+4$	$1\text{E}-5$	$4\text{E}-8$	$1\text{E}-4$	$1\text{E}-3$
		V, see ^{110}Sn	-	$4\text{E}+4$	$1\text{E}-5$	$5\text{E}-8$	-	-
51	Antimony-115 ²	D, all compounds except those given for V	$8\text{E}+4$	$2\text{E}+5$	$1\text{E}-4$	$3\text{E}-7$	$1\text{E}-3$	$1\text{E}-2$
		V, oxides, hydroxides, halides, sulfides, sulfates, and nitrates	-	$3\text{E}+5$	$1\text{E}-4$	$4\text{E}-7$	-	-
51	Antimony-116m ²	D, see ^{115}Sb	$2\text{E}+4$	$7\text{E}+4$	$3\text{E}-5$	$1\text{E}-7$	$3\text{E}-4$	$3\text{E}-1$
		V, see ^{115}Sb	-	$1\text{E}+5$	$6\text{E}-5$	$2\text{E}-7$	-	-
51	Antimony-116 ²	D, see ^{115}Sb	$7\text{E}+4$ St. wall ($9\text{E}+4$)	$3\text{E}+5$	$1\text{E}-4$	$4\text{E}-7$	-	-
		V, see ^{115}Sb	-	$3\text{E}+5$	$1\text{E}-4$	$5\text{E}-7$	$1\text{E}-3$	$1\text{E}-2$
51	Antimony-117	D, see ^{115}Sb	$7\text{E}+4$	$2\text{E}+5$	$9\text{E}-5$	$3\text{E}-7$	$9\text{E}-4$	$9\text{E}-3$
		V, see ^{115}Sb	-	$3\text{E}+5$	$1\text{E}-4$	$4\text{E}-7$	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Col. 2		Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
				Inhalation ALI (μ Ci)	DAC (μ Ci/ml)			
51	Antimony-118m	D, see 115Sb V, see 115Sb	6E+3 5E+3	2E+4 2E+4	8E-6 9E-6	3E-8 3E-8	7E-5 -	7E-4 -
51	Antimony-119	D, see 115Sb V, see 115Sb	2E+4 2E+4	5E+4 3E+4	2E-5 1E-5	6E-8 4E-8	2E-4 -	2E-3 -
51	Antimony-120 ² (16 min)	D, see 115Sb V, see 115Sb	1E+5 St. wall (2E+5) -	4E+5 - 5E+5	2E-4 - 2E-4	6E-7 - 7E-7	- 2E-3 -	- 2E-2 -
51	Antimony-120 (5.76 d)	D, see 115Sb V, see 115Sb	1E+3 9E+2	2E+3 1E+3	9E-7 5E-7	3E-9 2E-9	1E-5 -	1E-4 -
51	Antimony-122	D, see 115Sb V, see 115Sb	8E+2 LLI wall (8E+2) 7E+2	2E+3 - 1E+3	1E-6 - 4E-7	3E-9 - 2E-9	- 1E-5 -	- 1E-4 -
51	Antimony-124a ²	D, see 115Sb V, see 115Sb	3E+5 2E+5	8E+5 6E+5	4E-4 2E-4	1E-6 8E-7	3E-3 -	3E-2 -
51	Antimony-124	D, see 115Sb V, see 115Sb	6E+2 5E+2	9E+2 2E+2	4E-7 1E-7	1E-9 3E-10	7E-6 -	7E-5 -
51	Antimony-125	D, see 115Sb V, see 115Sb	2E+3 -	2E+3 5E+2	1E-6 2E-7	3E-9 7E-10	3E-5 -	3E-4 -
51	Antimony-126a ²	D, see 115Sb V, see 115Sb	5E+4 St. wall (7E+4) -	2E+5 - 2E+5	8E-5 - 8E-5	3E-7 - 3E-7	- 9E-4 -	- 9E-3 -
51	Antimony-126	D, see 115Sb V, see 115Sb	6E+2 5E+2	1E+3 5E+2	5E-7 2E-7	2E-9 7E-10	7E-6 -	7E-5 -
51	Antimony-127	D, see 115Sb V, see 115Sb	8E+2 LLI wall (8E+2) 7E+2	2E+3 - 9E+2	9E-7 - 4E-7	3E-9 - 1E-9	- 1E-5 -	- 1E-4 -
51	Antimony-128 ² (10.4 min)	D, see 115Sb V, see 115Sb	8E+4 St. wall (1E+5) -	4E+5 - 4E+5	2E-4 - 2E-4	5E-7 6E-7	- 1E-3 -	- 1E-2 -
51	Antimony-128 (9.01 h)	D, see 115Sb V, see 115Sb	1E+3 -	4E+3 3E+3	2E-6 1E-6	6E-9 5E-9	2E-5 -	2E-4 -
51	Antimony-129	D, see 115Sb V, see 115Sb	3E+3 -	9E+3 9E+3	4E-6 4E-6	1E-8 1E-8	4E-5 -	4E-4 -
51	Antimony-130 ²	D, see 115Sb V, see 115Sb	2E+4 -	6E+4 8E+4	3E-5 3E-5	9E-8 1E-7	3E-4 -	3E-3 -
51	Antimony-131 ²	D, see 115Sb V, see 115Sb	1E+4 Thyroid (2E+4) -	2E+4 Thyroid (4E+4) 2E+4 Thyroid (4E+4)	1E-5 - 1E-5	- 6E-8 -	- 2E-4 -	- 2E-3 -

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases To Sewers
			Col. 1 Dose Ingestion ALI (μ Ci)	Inhalation		Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
				Col. 2 ALI (μ Ci)	Col. 3 DAC (μ Ci/ml)			
52	Tellurium-116	D, all compounds except those given for W	8E+3	2E+4	9E+6	3E-8	1E-4	1E-3
		W, oxides, hydroxides, and nitrates	-	3E+4	1E+5	4E-8	-	-
52	Tellurium-121m	D, see ^{116}Te	5E+2 Bone surf (7E+2)	2E+2 Bone surf (4E+2)	8E-8	-	-	-
		W, see ^{116}Te	-	4E+2	2E+7	5E-10 6E-10	1E-5	1E-4
52	Tellurium-121	D, see ^{116}Te	3E+3	4E+3	2E+6	6E-9	4E-5	4E-4
		W, see ^{116}Te	-	3E+3	1E+6	4E-9	-	-
52	Tellurium-123m	D, see ^{116}Te	6E+2 Bone surf (1E+3)	2E+2 Bone surf (5E+2)	9E-8	-	-	-
		W, see ^{116}Te	-	5E+2	2E+7	8E-10 8E-10	1E-5	1E-4
52	Tellurium-123	D, see ^{116}Te	5E+2 Bone surf (1E+3)	2E+2 Bone surf (5E+2)	8E-8	-	-	-
		W, see ^{116}Te	-	4E+2 Bone surf (1E+3)	2E+7	7E-10	2E-5	2E-4
			-	-	-	2E-9	-	-
52	Tellurium-125m	D, see ^{116}Te	1E+3 Bone surf (1E+3)	4E+2 Bone surf (1E+3)	2E+7	-	-	-
		W, see ^{116}Te	-	7E+2	3E+7	1E-9 1E-9	2E-5	2E-4
52	Tellurium-127m	D, see ^{116}Te	6E+2	3E+2 Bone surf (4E+2)	1E+7	-	9E-6	9E-5
		W, see ^{116}Te	-	3E+2	1E+7	6E-10 4E-10	-	-
52	Tellurium-127	D, see ^{116}Te	7E+3	2E+4	9E+6	3E-8	1E-4	1E-3
		W, see ^{116}Te	-	2E+4	7E+6	2E-8	-	-
52	Tellurium-129m	D, see ^{116}Te	5E+2	6E+2	3E+7	9E-10	7E-6	7E-5
		W, see ^{116}Te	-	2E+2	1E+7	3E-10	-	-
52	Tellurium-129 ²	D, see ^{116}Te	3E+4	6E+4	3E+5	9E-8	4E-4	4E-3
		W, see ^{116}Te	-	7E+4	3E+5	1E-7	-	-
52	Tellurium-131m	D, see ^{116}Te	3E+2 Thyroid (6E+2)	4E+2 Thyroid (1E+3)	2E+7	-	-	-
		W, see ^{116}Te	-	4E+2 Thyroid (9E+2)	2E+7	2E-9	8E-6	8E-5
			-	-	-	1E-9	-	-
52	Tellurium-131 ²	D, see ^{116}Te	3E+3 Thyroid (6E+3)	5E+3 Thyroid (1E+4)	2E+6	-	-	-
		W, see ^{116}Te	-	5E+3 Thyroid (1E+4)	2E+6	2E-8	8E-5	8E-4
			-	-	-	2E-8	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Inhalation		Col. 1	Col. 2	Monthly Average Concentration (μ Ci/ml)
				ALI (μ Ci)	DLI (μ Ci/ml)	Air (μ Ci/ml)	Water (μ Ci/ml)	
52	Tellurium-132	O, see ^{116}Te	2E+2 Thyroid (7E+2)	2E+2 Thyroid (8E+2)	9E-8	-	-	-
		W, see ^{116}Te	-	2E+2 Thyroid (6E+2)	9E-8	1E-9	9E-6	9E-5
52	Tellurium-133 ²	O, see ^{116}Te	3E+3 Thyroid (6E+3)	5E+3 Thyroid (1E+4)	2E-6	-	-	-
		W, see ^{116}Te	-	5E+3 Thyroid (1E+4)	2E-6	2E-8	9E-5	9E-4
52	Tellurium-133 ²	O, see ^{116}Te	1E+4 Thyroid (3E+4)	2E+4 Thyroid (6E+4)	9E-6	-	-	-
		W, see ^{116}Te	-	2E+4 Thyroid (6E+4)	9E-6	8E-8	4E-4	4E-3
52	Tellurium-134 ²	O, see ^{116}Te	2E+4 Thyroid (2E+4)	2E+4 Thyroid (5E+4)	1E-5	-	-	-
		W, see ^{116}Te	-	2E+4 Thyroid (5E+4)	1E-5	7E-8	3E-4	3E-3
53	Iodine-120 ²	O, all compounds	1E+4 Thyroid (1E+4)	2E+4	9E-6	3E-8	-	-
53	Iodine-120 ²	O, all compounds	4E+3 Thyroid (8E+3)	9E+3 Thyroid (1E+4)	4E-6	-	2E-4	2E-3
53	Iodine-121	O, all compounds	1E+4 Thyroid (3E+4)	2E+4 Thyroid (5E+4)	8E-6	-	1E-4	1E-3
53	Iodine-123	O, all compounds	3E+3 Thyroid (1E+4)	6E+3 Thyroid (2E+4)	3E-6	-	-	-
53	Iodine-124	O, all compounds	5E+1 Thyroid (2E+2)	8E+1 Thyroid (3E+2)	3E-8	-	-	-
53	Iodine-125	O, all compounds	4E+1 Thyroid (1E+2)	6E+1 Thyroid (2E+2)	3E-8	-	-	-
53	Iodine-126	O, all compounds	2E+1 Thyroid (7E+1)	4E+1 Thyroid (1E+2)	1E-8	-	-	-
53	Iodine-128 ²	O, all compounds	4E+4 St. small (6E+4)	1E+5	5E-5	2E-7	-	-
53	Iodine-129	O, all compounds	9E+0 Thyroid (2E+1)	9E+0 Thyroid (3E+1)	4E-9	-	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion - All (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				All (μCi)	DAC ($\mu\text{Ci}/\text{ml}$)			
53	Iodine-130	D, all compounds	4E+2 Thyroid (1E+3)	7E+2 Thyroid (2E+3)	3E-7	-	-	-
53	Iodine-131	D, all compounds	3E+1 Thyroid (9E+1)	5E+1 Thyroid (2E+2)	2E-8	-	-	-
53	Iodine-132 ²	D, all compounds	4E+3 Thyroid (1E+4)	8E+3 Thyroid (2E+4)	4E-6	-	-	-
53	Iodine-132	D, all compounds	4E+3 Thyroid (9E+3)	8E+3 Thyroid (1E+4)	3E-6	-	-	-
53	Iodine-133	D, all compounds	1E+2 Thyroid (5E+2)	3E+2 Thyroid (9E+2)	1E-7	-	-	-
53	Iodine-134 ²	D, all compounds	2E+4 Thyroid (3E+4)	5E+4	2E-5	6E-8	-	-
53	Iodine-135	D, all compounds	8E+2 Thyroid (3E+3)	2E+3 Thyroid (4E+3)	7E-7	-	-	-
54	Xenon-120 ²	Submersion ¹	-	-	1E-5	4E-8	-	-
54	Xenon-121 ²	Submersion ¹	-	-	2E-6	1E-8	-	-
54	Xenon-122	Submersion ¹	-	-	7E-5	3E-7	-	-
54	Xenon-123	Submersion ¹	-	-	6E-6	3E-8	-	-
54	Xenon-125	Submersion ¹	-	-	2E-5	7E-8	-	-
54	Xenon-127	Submersion ¹	-	-	1E-5	6E-8	-	-
54	Xenon-129m	Submersion ¹	-	-	2E-4	9E-7	-	-
54	Xenon-131m	Submersion ¹	-	-	4E-4	2E-6	-	-
54	Xenon-133m	Submersion ¹	-	-	1E-4	6E-7	-	-
54	Xenon-133	Submersion ¹	-	-	1E-4	5E-7	-	-
54	Xenon-135m ²	Submersion ¹	-	-	9E-6	4E-8	-	-
54	Xenon-135	Submersion ¹	-	-	1E-5	7E-8	-	-
54	Xenon-136 ²	Submersion ¹	-	-	4E-6	2E-8	-	-
55	Cesium-125 ²	D, all compounds	5E+4 St. ex. 11 (9E+4)	1E+5	6E-5	2E-7	-	-
55	Cesium-127	D, all compounds	6E+4	9E+4	4E-5	1E-7	9E-4	9E-3

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{m}^3$)	Col. 2 Water ($\mu\text{Ci}/\text{m}^3$)	Monthly Average Concentration ($\mu\text{Ci}/\text{m}^3$)
				Col. 2 All (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{m}^3$)			
55	Cesium-129	D, all compounds	$2\text{E}+4$	$3\text{E}+4$	$1\text{E}+5$	$5\text{E}-8$	$3\text{E}-4$	$3\text{E}-3$
55	Cesium-130 ²	D, all compounds	$6\text{E}+4$ St. wall ($1\text{E}+5$)	$2\text{E}+5$	$8\text{E}-5$	$3\text{E}-7$	-	-
55	Cesium-131	D, all compounds	$2\text{E}+4$	$3\text{E}+4$	$1\text{E}+5$	$4\text{E}-8$	$3\text{E}-4$	$3\text{E}-3$
55	Cesium-132	D, all compounds	$3\text{E}+3$	$4\text{E}+3$	$2\text{E}-6$	$6\text{E}-9$	$4\text{E}-5$	$4\text{E}-4$
55	Cesium-134m	D, all compounds	$1\text{E}+5$ St. wall ($1\text{E}+5$)	$1\text{E}+5$	$6\text{E}-5$	$2\text{E}-7$	-	-
55	Cesium-134	D, all compounds	$7\text{E}+1$	$1\text{E}+2$	$4\text{E}-8$	$2\text{E}-10$	$9\text{E}-7$	$9\text{E}-6$
55	Cesium-135m ²	D, all compounds	$1\text{E}+5$	$2\text{E}+5$	$8\text{E}-5$	$3\text{E}-7$	$1\text{E}-3$	$1\text{E}-2$
55	Cesium-135	D, all compounds	$7\text{E}+2$	$1\text{E}+3$	$5\text{E}-7$	$2\text{E}-9$	$1\text{E}-5$	$1\text{E}-4$
55	Cesium-136	D, all compounds	$4\text{E}+2$	$7\text{E}+2$	$3\text{E}-7$	$9\text{E}-10$	$6\text{E}-6$	$6\text{E}-5$
55	Cesium-137	D, all compounds	$1\text{E}+2$	$2\text{E}+2$	$6\text{E}-8$	$2\text{E}-10$	$1\text{E}-6$	$1\text{E}-5$
55	Cesium-138 ²	D, all compounds	$2\text{E}+4$ St. wall ($3\text{E}+4$)	$6\text{E}+4$	$2\text{E}-5$	$8\text{E}-8$	-	-
56	Barium-126 ²	D, all compounds	$6\text{E}+3$	$2\text{E}+4$	$6\text{E}-6$	$2\text{E}-8$	$8\text{E}-5$	$8\text{E}-4$
56	Barium-128	D, all compounds	$5\text{E}+2$	$2\text{E}+3$	$7\text{E}-7$	$2\text{E}-9$	$7\text{E}-6$	$7\text{E}-5$
56	Barium-131m ²	D, all compounds	$4\text{E}+5$ St. wall ($5\text{E}+5$)	$1\text{E}+6$	$6\text{E}-4$	$2\text{E}-6$	-	-
56	Barium-131	D, all compounds	$3\text{E}+3$	$8\text{E}+3$	$3\text{E}-6$	$1\text{E}-8$	$4\text{E}-5$	$4\text{E}-4$
56	Barium-133m	D, all compounds	$2\text{E}+3$ LLI wall ($3\text{E}+3$)	$9\text{E}+3$	$4\text{E}-6$	$1\text{E}-8$	-	-
56	Barium-133	D, all compounds	$2\text{E}+3$	$7\text{E}+2$	$3\text{E}-7$	$9\text{E}-10$	$2\text{E}-5$	$2\text{E}-4$
56	Barium-135m	D, all compounds	$3\text{E}+3$	$1\text{E}+4$	$5\text{E}-6$	$2\text{E}-8$	$4\text{E}-5$	$4\text{E}-4$
56	Barium-137 ²	D, all compounds	$1\text{E}+4$	$3\text{E}+4$	$1\text{E}-5$	$4\text{E}-8$	$2\text{E}-4$	$2\text{E}-3$
56	Barium-140	D, all compounds	$5\text{E}+2$ LLI wall ($6\text{E}+2$)	$1\text{E}+3$	$6\text{E}-7$	$2\text{E}-9$	-	-
56	Barium-141 ²	D, all compounds	$2\text{E}+4$	$7\text{E}+4$	$3\text{E}-5$	$1\text{E}-7$	$3\text{E}-4$	$3\text{E}-3$
56	Barium-142 ²	D, all compounds	$5\text{E}+4$	$1\text{E}+5$	$6\text{E}-5$	$2\text{E}-7$	$7\text{E}-4$	$7\text{E}-3$
57	Lanthanum-131 ²	D, all compounds except those given for W	$5\text{E}+4$	$1\text{E}+5$	$5\text{E}-5$	$2\text{E}-7$	$6\text{E}-4$	$6\text{E}-3$
		W, oxides and hydroxides	-	$2\text{E}+5$	$7\text{E}-5$	$2\text{E}-7$	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion, ALI (μ Ci)	Col. 2 Inhalation		Col. 1 Air (μ Ci/m ³)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
				ALI (μ Ci)	DAC (μ Ci/ml)			
57	Lanthanum-132	O, see ¹³¹ La W, see ¹³¹ La	3E+3 -	1E+4 1E+4	4E-6 5E-6	1E-8 2E-8	4E-5 -	4E-4 -
57	Lanthanum-135	O, see ¹³¹ La W, see ¹³¹ La	4E+4 -	1E+5 9E+4	4E-5 4E-5	1E-7 1E-7	5E-4 -	5E-3 -
57	Lanthanum-137	O, see ¹³¹ La W, see ¹³¹ La	1E+4 -	6E+1 (7E+1) 3E+2 liver (3E+2)	3E-8 - 1E-7 -	- 1E-10 -	2E-4 -	2E-3 -
57	Lanthanum-138	O, see ¹³¹ La W, see ¹³¹ La	9E+2 -	4E+0 1E+1	1E-9 6E-9	5E-12 2E-11	1E-5 -	1E-4 -
57	Lanthanum-140	O, see ¹³¹ La W, see ¹³¹ La	6E+2 -	1E+3 1E+3	6E-7 5E-7	2E-9 1E-9	9E-6 -	9E-5 -
57	Lanthanum-141	O, see ¹³¹ La W, see ¹³¹ La	4E+3 -	9E+3 1E+4	4E-6 5E-6	1E-8 2E-8	5E-5 -	5E-4 -
57	Lanthanum-142 ²	O, see ¹³¹ La W, see ¹³¹ La	8E+3 -	2E+4 3E+4	9E-6 1E-5	3E-8 5E-8	1E-4 -	1E-3 -
57	Lanthanum-143 ²	O, see ¹³¹ La W, see ¹³¹ La	4E+4 St. wall (4E+4) -	1E+5 - 9E+4	4E-5 - 4E-5	1E-7 - 1E-7	- 5E-4 -	- 5E-3 -
58	Cerium-134	W, all compounds except those given for Y Y, oxides, hydroxides, and fluorides	5E+2 LLI wall (6E+2) -	7E+2 - 7E+2	3E-7 - 3E-7	1E-9 - 9E-10	- 8E-6 -	- 8E-5 -
58	Cerium-135	W, see ¹³⁴ Ce Y, see ¹³⁴ Ce	2E+3 -	4E+3 4E+3	2E-6 3E-6	5E-9 5E-9	2E-5 -	2E-4 -
58	Cerium-137m	W, see ¹³⁴ Ce Y, see ¹³⁴ Ce	2E+3 LLI wall (2E+3) -	4E+3 - 4E+3	2E-6 - 2E-6	6E-9 - 5E-9	- 3E-5 -	- 3E-4 -
58	Cerium-137	W, see ¹³⁴ Ce Y, see ¹³⁴ Ce	5E+4 -	1E+5 1E+5	6E-5 5E-5	2E-7 2E-7	7E-4 -	7E-3 -
58	Cerium-139	W, see ¹³⁴ Ce Y, see ¹³⁴ Ce	5E+3 -	8E+2 7E+2	3E-7 3E-7	1E-9 9E-10	7E-5 -	7E-4 -
58	Cerium-141	W, see ¹³⁴ Ce Y, see ¹³⁴ Ce	2E+3 LLI wall (2E+3) -	7E+2 - 6E+2	3E-7 - 2E-7	1E-9 - 8E-10	- 3E-5 -	- 3E-4 -
58	Cerium-143	W, see ¹³⁴ Ce Y, see ¹³⁴ Ce	1E+3 LLI wall (1E+3) -	2E+3 - 2E+3	8E-7 - 7E-7	3E-9 - 2E-9	- 2E-5 -	- 2E-4 -

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 ALI (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
58	Cerium-144	W, see ^{134}Ce	$2\text{E}+2$ tll wall ($3\text{E}+2$)	$3\text{E}+1$	$1\text{E}+8$	$4\text{E}-11$	-	-
		Y, see ^{134}Ce	-	$1\text{E}+1$	$6\text{E}+9$	$2\text{E}-11$	$3\text{E}-6$	$3\text{E}-5$
59	Praseodymium-136 ²	W, all compounds except those given for Y	$5\text{E}+4$ St. wall ($7\text{E}+4$)	$2\text{E}+5$	$1\text{E}+4$	$3\text{E}-7$	-	-
		Y, oxides, hydroxides, carbides, and fluorides	-	$2\text{E}+5$	$9\text{E}-5$	$3\text{E}-7$	$1\text{E}-3$	$1\text{E}-2$
59	Praseodymium-137 ²	W, see ^{136}Pr	$4\text{E}+4$	$2\text{E}+5$	$6\text{E}-5$	$2\text{E}-7$	$5\text{E}-4$	$5\text{E}-3$
		Y, see ^{136}Pr	-	$1\text{E}+5$	$6\text{E}-5$	$2\text{E}-7$	-	-
59	Praseodymium-138 ²	W, see ^{136}Pr	$1\text{E}+4$	$5\text{E}+4$	$2\text{E}-5$	$8\text{E}-8$	$1\text{E}-4$	$1\text{E}-3$
		Y, see ^{136}Pr	-	$4\text{E}+4$	$2\text{E}-5$	$6\text{E}-8$	-	-
59	Praseodymium-139 ²	W, see ^{136}Pr	$4\text{E}+4$	$1\text{E}+5$	$5\text{E}-5$	$2\text{E}-7$	$6\text{E}-4$	$6\text{E}-3$
		Y, see ^{136}Pr	-	$1\text{E}+5$	$5\text{E}-5$	$2\text{E}-7$	-	-
59	Praseodymium-142 ²	W, see ^{136}Pr	$8\text{E}+4$	$2\text{E}+5$	$7\text{E}-5$	$2\text{E}-7$	$1\text{E}-3$	$1\text{E}-2$
		Y, see ^{136}Pr	-	$1\text{E}+5$	$6\text{E}-5$	$2\text{E}-7$	-	-
59	Praseodymium-142 ²	W, see ^{136}Pr	$1\text{E}+3$	$2\text{E}+3$	$9\text{E}-7$	$3\text{E}-9$	$1\text{E}-5$	$1\text{E}-4$
		Y, see ^{136}Pr	-	$2\text{E}+3$	$8\text{E}-7$	$3\text{E}-9$	-	-
59	Praseodymium-143 ²	W, see ^{136}Pr	$9\text{E}+2$ tll wall ($1\text{E}+3$)	$8\text{E}+2$	$3\text{E}-7$	$1\text{E}-9$	-	-
		Y, see ^{136}Pr	-	$7\text{E}+2$	$3\text{E}-7$	$9\text{E}-10$	$2\text{E}-5$	$2\text{E}-4$
59	Praseodymium-144 ²	W, see ^{136}Pr	$3\text{E}+4$ St. wall ($4\text{E}+4$)	$1\text{E}+5$	$5\text{E}-5$	$2\text{E}-7$	-	-
		Y, see ^{136}Pr	-	$1\text{E}+5$	$5\text{E}-5$	$2\text{E}-7$	$6\text{E}-4$	$6\text{E}-3$
59	Praseodymium-145 ²	W, see ^{136}Pr	$3\text{E}+3$	$9\text{E}+3$	$4\text{E}-6$	$1\text{E}-8$	$4\text{E}-5$	$4\text{E}-4$
		Y, see ^{136}Pr	-	$8\text{E}+3$	$3\text{E}-6$	$1\text{E}-8$	-	-
59	Praseodymium-147 ²	W, see ^{136}Pr	$5\text{E}+4$ St. wall ($8\text{E}+4$)	$2\text{E}+5$	$8\text{E}-5$	$3\text{E}-7$	-	-
		Y, see ^{136}Pr	-	$2\text{E}+5$	$8\text{E}-5$	$3\text{E}-7$	$1\text{E}-3$	$1\text{E}-2$
60	Neodymium-136 ²	W, all compounds except those given for Y	$1\text{E}+4$	$6\text{E}+4$	$2\text{E}-5$	$8\text{E}-8$	$2\text{E}-4$	$2\text{E}-3$
		Y, oxides, hydroxides, carbides, and fluorides	-	$5\text{E}+4$	$2\text{E}-5$	$8\text{E}-8$	-	-
60	Neodymium-138 ²	W, see ^{136}Nd	$2\text{E}+3$	$6\text{E}+3$	$3\text{E}-6$	$9\text{E}-9$	$3\text{E}-5$	$3\text{E}-4$
		Y, see ^{136}Nd	-	$5\text{E}+3$	$2\text{E}-6$	$7\text{E}-9$	-	-
60	Neodymium-139 ²	W, see ^{136}Nd	$5\text{E}+3$	$2\text{E}+4$	$7\text{E}-6$	$2\text{E}-8$	$7\text{E}-5$	$7\text{E}-4$
		Y, see ^{136}Nd	-	$1\text{E}+4$	$6\text{E}-6$	$2\text{E}-8$	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				ALL (μCi)	DL ($\mu\text{Ci}/\text{ml}$)			
60	Neodymium-139 ²	W, see 136Nd	9E+4	3E+5	1E+4	5E-7	1E-3	1E-2
		Y, see 136Nd	-	3E+5	1E+4	4E-7	-	-
60	Neodymium-141	W, see 136Nd	2E+5	7E+5	3E+4	1E-6	2E-3	2E-2
		Y, see 136Nd	-	6E+5	3E+4	9E-7	-	-
60	Neodymium-147	W, see 136Nd	1E+3	9E+2	4E-7	1E-9	-	-
		Y, see 136Nd	LLI wall (1E+3)	-	-	-	2E-5	2E-4
60	Neodymium-149 ²	W, see 136Nd	1E+4	3E+4	1E+5	4E-8	1E-4	1E-3
		Y, see 136Nd	-	2E+4	1E+5	3E-8	-	-
60	Neodymium-151 ²	W, see 136Nd	7E+4	2E+5	8E+5	3E-7	9E-4	9E-3
		Y, see 136Nd	-	2E+5	8E+5	3E-7	-	-
61	Promethium-141 ²	W, all compounds except those given for Y	5E+4	2E+5	8E+5	3E-7	-	-
		Y, oxides, hydrides, carbides, and fluorides	SL wall (6E+4)	-	-	-	8E-4	8E-3
61	Promethium-143	W, see 141Pu	5E+3	6E+2	2E-7	8E-10	7E-5	7E-4
		Y, see 141Pu	-	7E+2	3E-7	1E-9	-	-
61	Promethium-144	W, see 141Pu	1E+3	1E+2	5E-8	2E-10	2E-5	2E-4
		Y, see 141Pu	-	1E+2	5E-8	2E-10	-	-
61	Promethium-145	W, see 141Pu	1E+4	2E+2	7E-8	-	1E-4	1E-3
		Y, see 141Pu	-	Bone surf. (2E+2)	-	3E-10	-	-
61	Promethium-146	W, see 141Pu	2E+3	5E+1	2E-8	7E-11	2E-5	2E-4
		Y, see 141Pu	-	4E+1	2E-8	6E-11	-	-
61	Promethium-147	W, see 141Pu	4E+3	1E+2	5E-8	-	-	-
		Y, see 141Pu	LLI wall (5E+3)	Bone surf. (2E+2)	-	3E-10	7E-5	7E-4
61	Promethium-148a	W, see 141Pu	7E+2	3E+2	1E-7	4E-10	1E-5	1E-4
		Y, see 141Pu	-	3E+2	1E-7	5E-10	-	-
61	Promethium-148	W, see 141Pu	4E+2	5E+2	2E-7	8E-10	-	-
		Y, see 141Pu	LLI wall (5E+2)	-	-	-	7E-6	7E-5
61	Promethium-149	W, see 141Pu	1E+1	2E+3	8E-7	3E-9	-	-
		Y, see 141Pu	LLI wall (1E+3)	-	-	-	2E-5	2E-4
61	Promethium-150	W, see 141Pu	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		Y, see 141Pu	-	2E+4	7E-6	2E-8	-	-
61	Promethium-151	W, see 141Pu	2E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		Y, see 141Pu	-	3E+3	1E-6	4E-9	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{m}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{m}$)
				Col. 2 ALI (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{m}$)			
62	Samarium-147 ²	V, all compounds	3E-4	1E-5	4E-5	1E-7	4E-4	4E-3
62	Samarium-147 ²	V, all compounds	5E-4 St. wall (6E-4)	2E-5	8E-5	2E-7	-	-
62	Samarium-147 ²	V, all compounds	8E-3	3E-4	1E-5	4E-8	1E-4	1E-3
62	Samarium-145	V, all compounds	6E-3	5E-2	2E-7	7E-10	8E-5	8E-4
62	Samarium-146	V, all compounds	1E-1 Bone surf (3E-1)	4E-2 Bone surf (6E-2)	1E-11	-	-	-
62	Samarium-147	V, all compounds	2E-1 Bone surf (3E-1)	4E-2 Bone surf (7E-2)	2E-11	-	-	-
62	Samarium-151	V, all compounds	1E-4 LLI wall (1E-4)	1E-2 Bone surf (2E-2)	4E-8	-	-	-
62	Samarium-153	V, all compounds	2E-3 LLI wall (2E-3)	3E-3	1E-6	4E-9	-	-
62	Samarium-155 ²	V, all compounds	6E-4 St. wall (8E-4)	2E-5	9E-5	1E-7	-	-
62	Samarium-156	V, all compounds	5E-3	9E-3	4E-6	1E-8	7E-5	7E-4
63	Europium-145	V, all compounds	2E-3	2E-3	8E-7	3E-9	2E-5	2E-4
63	Europium-146	V, all compounds	1E-3	1E-3	5E-7	2E-9	1E-5	1E-4
63	Europium-147	V, all compounds	3E-3	2E-3	7E-7	2E-9	4E-5	4E-4
63	Europium-148	V, all compounds	1E-3	4E-2	1E-7	5E-10	1E-5	1E-4
63	Europium-149	V, all compounds	1E-4	3E-3	1E-6	4E-9	2E-4	2E-3
63	Europium-150 (12.62 h)	V, all compounds	3E-3	8E-3	4E-6	1E-8	4E-5	4E-4
63	Europium-150 (34.2 y)	V, all compounds	8E-2	2E-1	8E-9	3E-11	1E-5	1E-4
63	Europium-152m	V, all compounds	3E-3	6E-3	3E-6	9E-9	4E-5	4E-4
63	Europium-152	V, all compounds	8E-2	2E-1	1E-8	3E-11	1E-5	1E-4
63	Europium-154	V, all compounds	5E-2	2E-1	8E-9	3E-11	7E-6	7E-5
63	Europium-155	V, all compounds	4E-3	9E-1 Bone surf (1E-2)	4E-8	-	5E-5	5E-4
63	Europium-156	V, all compounds	6E-2	5E-2	2E-7	6E-10	8E-6	8E-5

Atomic No.	Radioisotope	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Release to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{m}^3$)	Col. 2 Water ($\mu\text{Ci}/\text{m}^3$)	Monthly Average Concentration ($\mu\text{Ci}/\text{m}^3$)
				Col. 2 ALL (μCi)	Col. 3 SOL ($\mu\text{Ci}/\text{m}^3$)			
52	Eurprium-157	M, all compounds	2E+3	5E+3	2E-6	7E-9	3E-5	3E-4
63	Eurprium-156 ²	M, all compounds	2E+4	6E+4	2E-5	6E-6	3E-4	3E-3
64	Cadmium-145 ²	D, all compounds except those given for M	5E+4 SL, oral (5E+4)	2E+5	6E-5	2E-7	-	-
		M, oxides, hydroxides, and fluorides	-	2E+5	7E-5	2E-7	6E-4	6E-3
64	Cadmium-146	D, see ¹⁴⁵ Cd	1E+3	1E+2	5E-8	2E-10	2E-5	2E-4
		M, see ¹⁴⁵ Cd	-	3E+2	1E-7	4E-10	-	-
64	Cadmium-147	D, see ¹⁴⁵ Cd	2E+3	4E+3	2E-6	6E-9	3E-5	3E-4
		M, see ¹⁴⁵ Cd	-	4E+3	1E-6	5E-9	-	-
64	Cadmium-148	D, see ¹⁴⁵ Cd	2E+1 Bone surf (2E+1)	8E+3 Bone surf (2E+2)	3E-12	-	-	-
		M, see ¹⁴⁵ Cd	-	3E-2 Bone surf (6E-2)	1E-11	2E-14	3E-7	3E-6
64	Cadmium-149	D, see ¹⁴⁵ Cd	3E+3	2E+3	9E-7	3E-9	4E-5	4E-4
		M, see ¹⁴⁵ Cd	-	2E+3	1E-6	3E-9	-	-
64	Cadmium-151	D, see ¹⁴⁵ Cd	5E+3	4E+2 Bone surf (3E+2)	2E-7	-	9E-5	9E-4
		M, see ¹⁴⁵ Cd	-	1E+3	5E-7	3E-10	-	-
64	Cadmium-152	D, see ¹⁴⁵ Cd	2E+1 Bone surf (3E+1)	1E-2 Bone surf (2E-2)	4E-12	-	-	-
		M, see ¹⁴⁵ Cd	-	4E-2 Bone surf (3E-2)	2E-11	3E-14	4E-7	4E-6
64	Cadmium-153	D, see ¹⁴⁵ Cd	3E+3	1E+2 Bone surf (2E+2)	6E-8	-	6E-5	6E-4
		M, see ¹⁴⁵ Cd	-	6E+2	2E-7	3E-10	-	-
64	Cadmium-159	D, see ¹⁴⁵ Cd	3E+3	6E+3	3E-6	1E-8	4E-5	4E-4
		M, see ¹⁴⁵ Cd	-	6E+3	2E-6	6E-9	-	-
65	Terbium-147 ²	M, all compounds	9E+3	2E+6	1E-5	5E-8	2E-4	2E-3
66	Terbium-149	M, all compounds	5E+3	7E+2	3E-7	2E-9	2E-5	2E-4
66	Terbium-150	M, all compounds	5E+3	2E+4	9E-6	2E-8	7E-5	7E-4
66	Terbium-151	M, all compounds	4E+3	9E+3	6E-6	1E-8	5E-5	5E-4
66	Terbium-153	M, all compounds	5E+3	7E+3	2E-6	1E-8	2E-5	2E-4
66	Terbium-154	M, all compounds	2E+3	4E+3	3E-6	6E-9	2E-5	2E-4
66	Terbium-155	M, all compounds	6E+3	8E+3	3E-6	1E-8	8E-5	8E-4
66	Terbium-156a (5.0 h)	M, all compounds	2E+3	3E+4	1E-5	4E-8	2E-4	2E-3

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 ALI (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
65	Terbium-156m (24.4 h)	V, all compounds	$7\text{E}+3$	$8\text{E}+3$	$3\text{E}-6$	$1\text{E}-8$	$1\text{E}-4$	$1\text{E}-3$
65	Terbium-156	V, all compounds	$1\text{E}+3$	$1\text{E}+3$	$6\text{E}-7$	$2\text{E}-9$	$1\text{E}-5$	$1\text{E}-4$
65	Terbium-157	V, all compounds	$5\text{E}+4$ LLI wall ($5\text{E}+4$)	$3\text{E}+2$ Bone surf ($6\text{E}+2$)	$1\text{E}-7$	$8\text{E}-10$	$7\text{E}-4$	$7\text{E}-3$
65	Terbium-158	V, all compounds	$1\text{E}+3$	$2\text{E}+3$	$8\text{E}-9$	$3\text{E}-11$	$2\text{E}-5$	$2\text{E}-4$
65	Terbium-160	V, all compounds	$8\text{E}+2$	$2\text{E}+2$	$9\text{E}-8$	$3\text{E}-10$	$1\text{E}-5$	$1\text{E}-4$
65	Terbium-161	V, all compounds	$2\text{E}+3$ LLI wall ($2\text{E}+3$)	$2\text{E}+3$	$7\text{E}-7$	$2\text{E}-9$	$3\text{E}-5$	$3\text{E}-4$
66	Dysprosium-155	V, all compounds	$9\text{E}+3$	$3\text{E}+4$	$1\text{E}-5$	$4\text{E}-8$	$1\text{E}-4$	$1\text{E}-3$
66	Dysprosium-157	V, all compounds	$2\text{E}+4$	$6\text{E}+4$	$3\text{E}-5$	$9\text{E}-8$	$3\text{E}-4$	$3\text{E}-3$
66	Dysprosium-159	V, all compounds	$1\text{E}+4$	$2\text{E}+3$	$1\text{E}-6$	$3\text{E}-9$	$2\text{E}-4$	$2\text{E}-3$
66	Dysprosium-165	V, all compounds	$1\text{E}+4$	$5\text{E}+4$	$2\text{E}-5$	$6\text{E}-8$	$2\text{E}-4$	$2\text{E}-3$
66	Dysprosium-166	V, all compounds	$6\text{E}+2$ LLI wall ($8\text{E}+2$)	$7\text{E}+2$	$3\text{E}-7$	$1\text{E}-9$	$1\text{E}-5$	$1\text{E}-4$
67	Holmium-155 ²	V, all compounds	$4\text{E}+4$	$2\text{E}+5$	$6\text{E}-5$	$2\text{E}-7$	$6\text{E}-4$	$6\text{E}-3$
67	Holmium-157 ²	V, all compounds	$3\text{E}+5$	$1\text{E}+6$	$6\text{E}-4$	$2\text{E}-6$	$4\text{E}-3$	$4\text{E}-2$
67	Holmium-159 ²	V, all compounds	$2\text{E}+5$	$1\text{E}+6$	$4\text{E}-4$	$1\text{E}-6$	$3\text{E}-3$	$3\text{E}-2$
67	Holmium-161	V, all compounds	$1\text{E}+5$	$4\text{E}+5$	$2\text{E}-4$	$6\text{E}-7$	$1\text{E}-3$	$1\text{E}-2$
67	Holmium-162a ²	V, all compounds	$5\text{E}+4$	$3\text{E}+5$	$1\text{E}-4$	$4\text{E}-7$	$7\text{E}-4$	$7\text{E}-3$
67	Holmium-162 ²	V, all compounds	$8\text{E}+5$ St. wall ($8\text{E}+5$)	$2\text{E}+6$	$1\text{E}-3$	$3\text{E}-6$	$1\text{E}-2$	$1\text{E}-1$
67	Holmium-164a ²	V, all compounds	$1\text{E}+5$	$3\text{E}+5$	$1\text{E}-4$	$4\text{E}-7$	$1\text{E}-3$	$1\text{E}-2$
67	Holmium-164 ²	V, all compounds	$2\text{E}+5$ St. wall ($2\text{E}+5$)	$6\text{E}+5$	$3\text{E}-4$	$9\text{E}-7$	$3\text{E}-3$	$3\text{E}-2$
67	Holmium-166a	V, all compounds	$6\text{E}+2$	$7\text{E}+0$	$3\text{E}-9$	$9\text{E}-12$	$9\text{E}-6$	$9\text{E}-5$
67	Holmium-166	V, all compounds	$9\text{E}+2$ LLI wall ($9\text{E}+2$)	$2\text{E}+3$	$7\text{E}-7$	$2\text{E}-9$	$1\text{E}-5$	$1\text{E}-4$
67	Holmium-167	V, all compounds	$2\text{E}+4$	$6\text{E}+4$	$2\text{E}-5$	$8\text{E}-8$	$2\text{E}-4$	$2\text{E}-3$
68	Erbium-161	V, all compounds	$2\text{E}+4$	$6\text{E}+4$	$3\text{E}-5$	$9\text{E}-8$	$2\text{E}-4$	$2\text{E}-3$
68	Erbium-165	V, all compounds	$6\text{E}+4$	$2\text{E}+5$	$8\text{E}-5$	$3\text{E}-7$	$9\text{E}-4$	$9\text{E}-3$

Atomic No.	Radioisotope	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Col. 2 Inhalation ALI (μ Ci)	Col. 3 DAC (μ Ci/ml)	Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
68	Erbium-169	W, all compounds	3E+3 LLI wall (4E+3)	3E+3	1E-6	4E-9	-	-
68	Erbium-171	W, all compounds	4E+3	1E+4	4E-6	1E-8	5E-5	5E-4
68	Erbium-172	W, all compounds	1E+3 LLI wall (1E+3)	1E+3	6E-7	2E-9	-	-
69	Thulium-162 ²	W, all compounds	7E+4 St. wall (7E+4)	3E+5	1E-4	4E-7	-	-
69	Thulium-166	W, all compounds	4E+3	1E+4	6E-6	2E-8	6E-5	6E-4
69	Thulium-167	W, all compounds	2E+3 LLI wall (2E+3)	2E+3	8E-7	3E-9	-	-
69	Thulium-170	W, all compounds	8E+2 LLI wall (1E+3)	2E+2	9E-8	3E-10	-	-
69	Thulium-171	W, all compounds	1E+4 LLI wall (1E+4)	3E+2 Bone surf (6E+2)	1E-7	-	-	-
69	Thulium-172	W, all compounds	7E+2 LLI wall (8E+2)	1E+3	5E-7	2E-9	-	-
69	Thulium-173	W, all compounds	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
69	Thulium-175 ²	W, all compounds	7E+4 St. wall (9E+4)	3E+5	1E-4	4E-7	-	-
70	Ytterbium-162 ²	W, all compounds except those given for Y	7E+4	3E+5	1E-4	4E-7	1E-3	1E-2
	Y, oxides, hydroxides, and fluorides		-	3E+5	1E-4	4E-7	-	-
70	Ytterbium-166 W, see 162Yb Y, see 162Yb		1E+3 -	2E+3 2E+3	8E-7 8E-7	3E-9 3E-9	2E-5 -	2E-4 -
70	Ytterbium-167 ² W, see 162Yb Y, see 162Yb		3E+5 -	8E+5 7E+5	3E-4 3E-4	2E-6 1E-6	4E-3 -	4E-2 -
70	Ytterbium-169 W, see 162Yb Y, see 162Yb		2E+3 -	8E+2 7E+2	4E-7 3E-7	3E-9 1E-9	2E-5 -	2E-4 -
70	Ytterbium-175 W, see 162Yb Y, see 162Yb		3E+3 LLI wall (3E+3) -	4E+3 3E+3	1E-6 1E-6	3E-9 5E-9	- 4E-5	- 4E-4
70	Ytterbium-177 ² W, see 162Yb Y, see 162Yb		2E+4 -	5E+4 5E+4	2E-5 2E-5	7E-8 6E-8	2E-4 -	2E-3 -
70	Ytterbium-178 ² W, see 162Yb Y, see 162Yb		1E+4 -	4E+4 4E+4	2E-5 2E-5	6E-8 5E-8	2E-4 -	2E-3 -

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Inhalation		Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
				ALI (μ Ci)	DAL (μ Ci/ml)			
71	Lutetium-169	W, all compounds except those given for Y	3E+3	4E+3	2E-6	6E-9	3E-5	3E-4
		Y, oxides, hydroxides, and fluorides	-	4E+3	2E-6	6E-9	-	-
71	Lutetium-170	W, see ^{169}Lu Y, see ^{169}Lu	1E+3 -	2E+3 2E+3	9E-7 8E-7	3E-9 3E-9	2E-5 -	2E-4 -
71	Lutetium-171	W, see ^{169}Lu Y, see ^{169}Lu	2E+3 -	2E+3 2E+3	8E-7 8E-7	3E-9 3E-9	3E-5 -	3E-4 -
71	Lutetium-172	W, see ^{169}Lu Y, see ^{169}Lu	1E+3 -	1E+3 1E+3	5E-7 5E-7	2E-9 2E-9	1E-5 -	1E-4 -
71	Lutetium-173	W, see ^{169}Lu Y, see ^{169}Lu	5E+3 -	3E+2 (5E+2) 3E+2	1E-7 -	- 6E-10 4E-10	7E-5 -	7E-4 -
71	Lutetium-174a	W, see ^{169}Lu Y, see ^{169}Lu	2E+3 (3E+3) -	2E+2 Bone surf (3E+2) 2E+2	1E-7 -	- 5E-10 3E-10	- 4E-5 -	- 4E-4 -
71	Lutetium-174	W, see ^{169}Lu Y, see ^{169}Lu	5E+3 -	1E+2 Bone surf (2E+2) 2E+2	5E-8 -	- 3E-10 2E-10	7E-5 -	7E-4 -
71	Lutetium-176a	W, see ^{169}Lu Y, see ^{169}Lu	8E+3 -	3E+4 2E+4	1E-5 9E-6	3E-8 3E-8	1E-4 -	1E-3 -
71	Lutetium-176	W, see ^{169}Lu Y, see ^{169}Lu	7E+2 -	5E+0 Bone surf (1E+1) 8E+0	2E-9 -	- 2E-11 1E-11	1E-5 -	1E-4 -
71	Lutetium-177a	W, see ^{169}Lu Y, see ^{169}Lu	7E+2 -	1E+2 Bone surf (1E+2) 8E+1	5E-8 -	- 2E-10 1E-10	1E-5 -	1E-4 -
71	Lutetium-177	W, see ^{169}Lu Y, see ^{169}Lu	2E+3 (3E+3) -	2E+3 -	9E-7 -	3E-9 -	- 4E-5 -	- 4E-4 -
71	Lutetium-178a ²	W, see ^{169}Lu Y, see ^{169}Lu	5E+4 St. wall (6E+4) -	2E+5 -	8E-5 -	3E-7 -	- 8E-4 -	- 8E-3 -
71	Lutetium-178 ²	W, see ^{169}Lu Y, see ^{169}Lu	4E+4 St. wall (4E+4) -	1E+5 -	5E-5 -	2E-7 -	- 6E-4 -	- 6E-3 -
71	Lutetium-179	W, see ^{169}Lu Y, see ^{169}Lu	6E+3 -	2E+4 2E+4	8E-6 6E-6	3E-8 3E-8	9E-5 -	9E-4 -

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 All (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
72	Neptunium-236	O, all compounds except those given for W	3E+3	6E+3	2E-6	8E-9	4E-5	4E-4
		W, oxides, hydroxides, carbides, and nitrides	-	5E+3	2E-6	6E-9	-	-
72	Neptunium-237	O, see 170 _{HT}	1E+3	9E+0 Bone surf (2E+1)	4E-9	-	2E-5	2E-4
		W, see 170 _{HT}	-	4E+1 Bone surf (6E+1)	2E-8	3E-11	-	-
72	Neptunium-237	O, see 170 _{HT}	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W, see 170 _{HT}	-	1E+4	5E-6	2E-8	-	-
72	Neptunium-237	O, see 170 _{HT}	3E+3	9E+2 Bone surf (1E+3)	4E-7	-	4E-5	4E-4
		W, see 170 _{HT}	-	1E+3	5E-7	1E-9	-	-
72	Neptunium-237 ²	O, see 170 _{HT}	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
		W, see 170 _{HT}	-	9E+4	4E-5	1E-7	-	-
72	Neptunium-238	O, see 170 _{HT}	3E+2	1E+0 Bone surf (2E+0)	5E-10	-	3E-6	3E-5
		W, see 170 _{HT}	-	5E+0 Bone surf (9E+0)	2E-9	3E-12	-	-
72	Neptunium-238	O, see 170 _{HT}	1E+3	3E+2 Bone surf (6E+2)	1E-7	-	1E-5	1E-4
		W, see 170 _{HT}	-	6E+2	3E-7	8E-10	-	-
72	Neptunium-239	O, see 170 _{HT}	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see 170 _{HT}	-	3E+4	1E-5	4E-8	-	-
72	Neptunium-241	O, see 170 _{HT}	1E+3	2E+2 Bone surf (4E+2)	7E-8	-	2E-5	2E-4
		W, see 170 _{HT}	-	4E+2	2E-7	6E-10	-	-
72	Neptunium-242 ²	O, see 170 _{HT}	4E+4	9E+4	4E-5	1E-7	5E-4	5E-3
		W, see 170 _{HT}	-	1E+5	6E-5	2E-7	-	-
72	Neptunium-242	O, see 170 _{HT}	2E+2 Bone surf (4E+2)	8E-1 Bone surf (2E+0)	3E-10	-	-	-
		W, see 170 _{HT}	-	3E+0 Bone surf (7E+0)	1E-9	2E-12	5E-6	5E-5
72	Neptunium-243 ²	O, see 170 _{HT}	2E+4	5E+4	2E-5	6E-8	3E-4	3E-3
		W, see 170 _{HT}	-	6E+4	2E-5	8E-8	-	-
72	Neptunium-244	O, see 170 _{HT}	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		W, see 170 _{HT}	-	6E+3	3E-6	9E-9	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Inhalation		Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
				ALI (μ Ci)	DAL (μ Ci/ml)			
73	Tantalum-172 ²	W, all compounds except those given for Y Y, elemental Ta, oxides, hydroxides, halides, carbides, nitrates, and nitrides	4E-4	1E-5	5E-5	2E-7	5E-4	5E-3
73	Tantalum-173	W, see 172 _{Ta} Y, see 172 _{Ta}	7E-3	2E-4	8E-6	3E-8	9E-5	9E-4
73	Tantalum-174 ²	W, see 172 _{Ta} Y, see 172 _{Ta}	3E-4	1E-5	4E-5	1E-7	4E-4	4E-3
73	Tantalum-175	W, see 172 _{Ta} Y, see 172 _{Ta}	6E-3	2E-4	7E-6	2E-8	8E-5	8E-4
73	Tantalum-176	W, see 172 _{Ta} Y, see 172 _{Ta}	4E-3	1E-4	5E-6	2E-8	5E-5	5E-4
73	Tantalum-177	W, see 172 _{Ta} Y, see 172 _{Ta}	1E-4	2E-4	8E-6	3E-8	2E-4	2E-3
73	Tantalum-178	W, see 172 _{Ta} Y, see 172 _{Ta}	2E-4	9E-4	4E-5	1E-7	2E-4	2E-3
73	Tantalum-179	W, see 172 _{Ta} Y, see 172 _{Ta}	2E-4	5E-3	2E-6	8E-9	3E-4	3E-3
73	Tantalum-180a	W, see 172 _{Ta} Y, see 172 _{Ta}	2E-4	7E-4	3E-5	9E-8	3E-4	3E-3
73	Tantalum-180	W, see 172 _{Ta} Y, see 172 _{Ta}	1E-3	4E-2	2E-7	6E-10	2E-5	2E-4
73	Tantalum-182a ²	W, see 172 _{Ta} Y, see 172 _{Ta}	2E-5 St. wall (2E-5)	5E-5	2E-4	8E-7	-	-
73	Tantalum-182	W, see 172 _{Ta} Y, see 172 _{Ta}	8E-2	3E-2	1E-7	5E-10	1E-5	1E-4
73	Tantalum-183	W, see 172 _{Ta} Y, see 172 _{Ta}	9E-2 LLI wall (1E-3)	1E-3	5E-7	2E-9	-	-
73	Tantalum-184	W, see 172 _{Ta} Y, see 172 _{Ta}	2E-3	5E-3	2E-6	8E-9	3E-5	3E-4
73	Tantalum-185 ²	W, see 172 _{Ta} Y, see 172 _{Ta}	3E-4	7E-4	3E-5	1E-7	4E-4	4E-3
73	Tantalum-186 ²	W, see 172 _{Ta} Y, see 172 _{Ta}	5E-4 St. wall (7E-4)	2E-5	1E-4	3E-7	-	-
74	Tungsten-176	O, all compounds	1E-4	5E-4	2E-5	7E-8	1E-4	1E-3
74	Tungsten-177	O, all compounds	2E-4	9E-4	4E-5	1E-7	3E-4	3E-3

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{m}^3$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{m}^3$)
				Col. 2 ALL (μCi)	Col. 3 SAC ($\mu\text{Ci}/\text{m}^3$)			
74	Tungsten-178	0, all compounds	5E+3	2E+4	8E+6	3E-8	7E-5	7E-4
74	Tungsten-179 ²	0, all compounds	5E+6	2E+6	7E+4	2E-6	7E-3	7E-2
74	Tungsten-181	0, all compounds	2E+4	3E+4	1E+5	5E-8	2E-4	2E-3
74	Tungsten-185	0, all compounds	2E+3 SL wall (3E+3)	2E+3	3E+6	9E-9	-	-
74	Tungsten-187	0, all compounds	2E+8	9E+3	8E+6	1E-8	3E-5	3E-4
74	Tungsten-188	0, all compounds	4E+2 SL wall (5E+2)	1E+3	3E+7	2E-9	-	-
75	Rhenium-177 ²	0, all compounds except those given for W	9E+4 SL wall (2E+5)	3E+5	1E+4	4E-7	-	-
	W, oxides, hydroxides, and nitrides		-	4E+5	1E+4	5E-7	-	-
75	Rhenium-178 ²	0, see 177 Re	2E+4 SL wall (2E+5)	2E+5	1E+4	4E-7	-	-
	W, see 177 Re		-	3E+5	1E+4	4E-7	1E-3	3E-2
75	Rhenium-181	0, see 177 Re W, see 177 Re	3E+3 -	9E+3 8E+3	4E+6 4E+6	1E-8 2E-8	7E-5 -	7E-4 -
75	Rhenium-182 (12.7 h)	0, see 177 Re W, see 177 Re	7E+3 -	7E+4 2E+4	5E+6 6E+6	2E-8 2E-8	9E-5 -	9E-4 -
75	Rhenium-182 (64.0 h)	0, see 177 Re W, see 177 Re	2E+3 -	2E+3 2E+3	1E+6 9E+7	3E-9 2E-8	2E-5 -	2E-4 -
75	Rhenium-184a	0, see 177 Re W, see 177 Re	2E+3 -	3E+3 4E+2	1E+6 2E+7	4E-9 5E-10	3E-5 -	3E-4 -
75	Rhenium-184	0, see 177 Re W, see 177 Re	2E+3 -	4E+3 3E+3	1E+6 6E+7	5E-9 2E-9	3E-5 -	3E-4 -
75	Rhenium-186a	0, see 177 Re W, see 177 Re	1E+3 SL wall (2E+3)	2E+3 SL wall (2E+3)	2E+7 2E+2	- 4E-8	- 2E-10	- 2E-4
75	Rhenium-186	0, see 177 Re W, see 177 Re	2E+3 -	3E+3 2E+3	2E+6 3E+7	4E-8 2E-9	3E-5 -	2E-4 -
75	Rhenium-187	0, see 177 Re W, see 177 Re	6E+5 -	8E+5 SL wall (9E+5)	4E+6 1E+6	- 1E-6	8E-3 -	8E-2 -
75	Rhenium-188 ²	0, see 177 Re W, see 177 Re	4E+4 -	1E+5 1E+5	6E+5 6E+5	2E-7 2E-7	1E-3 -	1E-2 -
75	Rhenium-188	0, see 177 Re W, see 177 Re	2E+3 -	3E+3 3E+3	1E+6 2E+6	4E-8 6E-9	2E-5 -	2E-4 -

Atomic No.	Radioisotope	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion All (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 All (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
75	Rhenium-189	O, see ¹⁷⁷ Re W, see ¹⁷⁷ Re	3E+3	5E+1	2E-4	2E-9	4E-5	4E-4
76	Osmium-180 ²	O: all compounds except those given for W and Y W, halides and nitrates Y, oxides and hydroxides	1E+5	4E+5	2E-4	5E-7	1E-3	1E-2
76	Osmium-181 ²	O, see ¹⁸⁰ Os W, see ¹⁸⁰ Os Y, see ¹⁸⁰ Os	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
76	Osmium-182	O, see ¹⁸⁰ Os W, see ¹⁸⁰ Os Y, see ¹⁸⁰ Os	2E+3	6E+3	2E-4	6E-9	3E-5	3E-4
76	Osmium-185	O, see ¹⁸⁰ Os W, see ¹⁸⁰ Os Y, see ¹⁸⁰ Os	2E+3	5E+2	2E-7	7E-10	3E-5	3E-4
76	Osmium-186a	O, see ¹⁸⁰ Os W, see ¹⁸⁰ Os Y, see ¹⁸⁰ Os	6E+4	2E+5	1E-4	3E-7	1E-3	1E-2
76	Osmium-191a	O, see ¹⁸⁰ Os W, see ¹⁸⁰ Os Y, see ¹⁸⁰ Os	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
76	Osmium-191	O, see ¹⁸⁰ Os (LLI wall (3E+3)) W, see ¹⁸⁰ Os Y, see ¹⁸⁰ Os	2E+3	2E+3	9E-7	3E-9	3E-5	3E-4
76	Osmium-193	O, see ¹⁸⁰ Os (LLI wall (2E+3)) W, see ¹⁸⁰ Os Y, see ¹⁸⁰ Os	2E+3	5E+1	2E-6	6E-9	2E-5	2E-4
76	Osmium-194	O, see ¹⁸⁰ Os (LLI wall (6E+2)) W, see ¹⁸⁰ Os Y, see ¹⁸⁰ Os	4E+2	4E+1	2E-8	6E-11	8E-11	8E-5
77	Iridium-182 ²	O: all compounds except those given for W and Y W, halides, nitrates, and metallic iridium Y, oxides and hydroxides	4E+4 5E wall (4E+4)	1E+5	6E-5	2E-7	6E-4	6E-3
77	Iridium-184	O, see ¹⁸² Ir W, see ¹⁸² Ir Y, see ¹⁸² Ir	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Source
			Col. 1 Oral Ingestion ALI (μ Ci)	Inhalation		Col. 1 Air (μ Ci/m ³)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
				ALI (μ Ci)	DAC			
					(μ Ci/ml)			
77	Iridium-185	O, see ¹⁸⁵ Ir V, see ¹⁸⁵ Ir Y, see ¹⁸⁵ Ir	5E+3 - -	1E+4 1E+4 1E+4	5E-6 5E-6 4E-6	2E-8 2E-8 1E-8	7E-5 - -	7E-4 - -
77	Iridium-186	O, see ¹⁸⁶ Ir V, see ¹⁸⁶ Ir Y, see ¹⁸⁶ Ir	2E+3 - -	8E+3 6E+3 6E+3	3E-6 3E-6 2E-6	1E-8 9E-9 8E-9	3E-5 - -	3E-4 - -
77	Iridium-187	O, see ¹⁸⁷ Ir V, see ¹⁸⁷ Ir Y, see ¹⁸⁷ Ir	1E+4 - -	3E+4 3E+4 3E+4	1E-5 1E-5 1E-6	5E-8 4E-8 4E-8	1E-4 - -	1E-3 - -
77	Iridium-188	O, see ¹⁸⁸ Ir V, see ¹⁸⁸ Ir Y, see ¹⁸⁸ Ir	2E+3 - -	5E+3 4E+3 3E+3	2E-6 1E-6 1E-6	6E-8 5E-8 5E-8	3E-5 - -	3E-4 - -
77	Iridium-189	O, see ¹⁸⁹ Ir V, see ¹⁸⁹ Ir Y, see ¹⁸⁹ Ir	3E+3 (5E+3) -	5E+3 - 4E+3	2E-6 - 2E-6	7E-8 - 5E-9	- 7E-5 -	- 7E-4 -
77	Iridium-190m ²	O, see ^{189m} Ir V, see ^{189m} Ir Y, see ^{189m} Ir	2E+5 - -	2E+5 2E+5 2E+5	8E-5 3E-5 3E-5	1E-7 3E-7 3E-7	2E-3 - -	2E-2 - -
77	Iridium-190	O, see ¹⁹⁰ Ir V, see ¹⁹⁰ Ir Y, see ¹⁹⁰ Ir	1E+3 - -	9E+2 1E+3 9E+2	4E-7 4E-7 4E-7	1E-9 1E-9 1E-9	1E-5 - -	1E-4 - -
77	Iridium-192m	O, see ^{192m} Ir V, see ^{192m} Ir Y, see ^{192m} Ir	3E+8 - -	3E+1 2E+2 2E+1	4E-8 9E-8 6E-9	3E-10 3E-10 2E-11	4E-5 - -	4E-4 - -
77	Iridium-192	O, see ¹⁹² Ir V, see ¹⁹² Ir Y, see ¹⁹² Ir	9E+2 - -	3E+2 4E+2 2E+2	3E-7 2E-7 8E-8	4E-10 6E-10 3E-10	1E-5 - -	1E-4 - -
77	Iridium-194m	O, see ^{194m} Ir V, see ^{194m} Ir Y, see ^{194m} Ir	6E+2 - -	9E+1 2E+2 2E+2	4E-8 3E-8 4E-8	1E-10 2E-10 1E-10	9E-6 - -	9E-5 - -
77	Iridium-194	O, see ¹⁹⁴ Ir V, see ¹⁹⁴ Ir Y, see ¹⁹⁴ Ir	3E+8 - -	3E+3 2E+3 2E+3	3E-6 9E-7 8E-7	4E-8 3E-8 3E-8	1E-5 - -	1E-4 - -
77	Iridium-195m	O, see ^{195m} Ir V, see ^{195m} Ir Y, see ^{195m} Ir	8E+3 - -	2E+4 3E+4 2E+4	3E-5 1E-5 9E-6	3E-8 4E-8 3E-8	1E-4 - -	1E-3 - -
77	Iridium-195	O, see ¹⁹⁵ Ir V, see ¹⁹⁵ Ir Y, see ¹⁹⁵ Ir	1E+4 - -	4E+4 5E+4 4E+4	2E-5 2E-5 2E-5	6E-8 3E-8 6E-8	2E-4 - -	2E-3 - -
78	Platinum-186	O, all compounds	1E+4	4E+4	2E-5	5E-8	2E-4	2E-3
78	Platinum-188	O, all compounds	2E+3	2E+3	7E-7	2E-9	2E-6	2E-4
78	Platinum-189	O, all compounds	1E+4	3E+4	1E-5	4E-8	1E-4	1E-3
78	Platinum-191	O, all compounds	4E+3	8E+3	4E-6	1E-8	5E-5	5E-4

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Col. 2	Col. 3	Col. 1	Col. 2	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
			Inhalation			Air	Water	
			(μCi)	(μCi)	($\mu\text{Ci}/\text{ml}$)	($\mu\text{Ci}/\text{ml}$)	($\mu\text{Ci}/\text{ml}$)	($\mu\text{Ci}/\text{ml}$)
78	Platinum-193m	D, all compounds	3E+3 LLI wall (3E+4)	6E+3	3E-6	8E-9	-	-
78	Platinum-193	D, all compounds	4E+4 LLI wall (5E+4)	2E+4	1E-5	3E-8	-	-
78	Platinum-195m	D, all compounds	2E+3 LLI wall (2E+3)	4E+3	2E-6	6E-9	-	-
78	Platinum-197m ²	D, all compounds	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
78	Platinum-197	D, all compounds	3E+3	1E+4	4E-6	1E-8	4E-5	4E-4
78	Platinum-199 ²	D, all compounds	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
78	Platinum-200	D, all compounds	1E+3	3E+3	1E-6	5E-9	2E-5	2E-4
79	Gold-193	D, all compounds except those given for W and Y	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, halides and nitrates	-	2E+4	9E-6	3E-8	-	-
		Y, oxides and hydroxides	-	2E+4	8E-6	3E-8	-	-
79	Gold-194	D, see ¹⁹³ Au	3E+3	8E+3	3E-6	3E-8	4E-5	4E-4
		W, see ¹⁹³ Au	-	5E+3	2E-6	8E-9	-	-
		Y, see ¹⁹³ Au	-	5E+3	2E-6	7E-9	-	-
79	Gold-195	D, see ¹⁹³ Au	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W, see ¹⁹³ Au	-	1E+3	6E-7	2E-9	-	-
		Y, see ¹⁹³ Au	-	4E+2	2E-7	6E-10	-	-
79	Gold-196m	D, see ¹⁹³ Au	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
		W, see ¹⁹³ Au	-	1E+3	5E-7	2E-9	-	-
		Y, see ¹⁹³ Au	-	1E+3	5E-7	2E-9	-	-
79	Gold-198	D, see ¹⁹³ Au	1E+3	4E+3	2E-6	5E-9	2E-5	2E-4
		W, see ¹⁹³ Au	-	2E+3	8E-7	3E-9	-	-
		Y, see ¹⁹³ Au	-	2E+3	7E-7	2E-9	-	-
79	Gold-199	D, see ¹⁹³ Au	3E+3 LLI wall (3E+3)	9E+3	4E-6	1E-8	-	-
		W, see ¹⁹³ Au	-	4E+3	2E-6	6E-9	4E-5	4E-4
		Y, see ¹⁹³ Au	-	4E+3	2E-6	5E-9	-	-
79	Gold-200m	D, see ¹⁹³ Au	1E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see ¹⁹³ Au	-	3E+3	1E-6	4E-9	-	-
		Y, see ¹⁹³ Au	-	2E+4	1E-6	3E-9	-	-
79	Gold-200 ²	D, see ¹⁹³ Au	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
		W, see ¹⁹³ Au	-	8E+4	3E-5	1E-7	-	-
		Y, see ¹⁹³ Au	-	7E+4	3E-5	1E-7	-	-
79	Gold-201 ²	D, see ¹⁹³ Au	7E+4 St. wall (9E+4)	2E+5	9E-5	3E-7	-	-
		W, see ¹⁹³ Au	-	2E+5	1E-4	3E-7	1E-3	1E-2
		Y, see ¹⁹³ Au	-	2E+5	9E-5	3E-7	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Col. 2	Col. 3 Inhalation DAC (μ Ci/ml)	Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
80	Mercury-193m	Vapor Organic D D, sulfates W, oxides, hydroxides, halides, nitrates, and sulfides	- 4E+3 3E+3	8E+3 1E+4 9E+3	4E-6 5E-6 4E-6	1E-8 2E-8 1E-8	- 6E-5 4E-5	- 6E-4 4E-4
80	Mercury-193	Vapor Organic D D, see 193mHg W, see 193mHg	- 2E+4 2E+4 -	3E+4 6E+4 4E+4 4E+4	1E-5 3E-5 2E-5 2E-5	4E-8 9E-8 6E-8 6E-8	- 3E-4 2E-4 -	- 3E-3 2E-3 -
80	Mercury-194	Vapor Organic D D, see 193mHg W, see 193mHg	- 2E+1 8E+2 -	3E+1 3E+1 4E+1 1E+2	1E-8 1E-8 2E-8 5E-8	4E-11 4E-11 6E-11 2E-10	- 2E-7 1E-5 -	- 2E-6 1E-4 -
80	Mercury-195m	Vapor Organic D D, see 193mHg W, see 193mHg	- 3E+3 2E+3 -	4E+3 6E+3 5E+3 4E+3	2E-6 3E-6 2E-6 2E-6	6E-9 8E-9 7E-9 5E-9	- 4E-5 3E-5 -	- 4E-4 3E-4 -
80	Mercury-195	Vapor Organic D D, see 193mHg W, see 193mHg	- 2E+4 1E+4 -	3E+4 5E+4 4E+4 3E+4	1E-5 2E-5 1E-5 1E-5	4E-8 6E-8 5E-8 5E-8	- 2E-4 2E-4 -	- 2E-3 2E-3 -
80	Mercury-197m	Vapor Organic D D, see 193mHg W, see 193mHg	- 4E+3 3E+3 -	5E+3 9E+3 7E+3 5E+3	2E-6 4E-6 3E-6 2E-6	7E-9 1E-8 1E-8 7E-9	- 5E-5 4E-5 -	- 5E-4 4E-4 -
80	Mercury-197	Vapor Organic D D, see 193mHg W, see 193mHg	- 7E+3 6E+3 -	8E+3 1E+4 1E+4 9E+3	4E-6 6E-6 5E-6 4E-6	1E-8 2E-8 2E-8 1E-8	- 9E-5 8E-4 -	- 9E-4 8E-4 -
80	Mercury-199a ²	Vapor Organic D D, see 193mHg W, see 193mHg	- 6E+4 5E+4 6E+4	8E+4 2E+5 1E+5 2E+5	3E-5 7E-5 6E-5 7E-5	1E-7 2E-7 2E-7 2E-7	- 1E-3 8E-4 -	- 1E-2 8E-3 -
80	Mercury-203	Vapor Organic D D, see 193mHg W, see 193mHg	- 5E+2 2E+3 -	8E+2 8E+2 1E+3 1E+3	4E-7 3E-7 5E-7 5E-7	1E-9 1E-9 2E-9 2E-9	- 7E-6 3E-5 -	- 7E-5 3E-4 -
81	Thallium-194a ²	D, all compounds	5E+4 5E+4 (7E+4)	2E+5 -	6E-5 -	2E-7 -	- 1E-3	- 1E-2

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Air ($\mu\text{Ci}/\text{ml}$)	Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 All (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
81	Thallium-194 ²	D, all compounds	3E-5 SL unit (3E-5)	6E-5	2E-4	8E-7	-	-
81	Thallium-195 ²	D, all compounds	6E-4	1E-5	5E-5	2E-7	9E-4	9E-3
81	Thallium-197	D, all compounds	7E-4	1E-5	5E-5	2E-7	1E-3	1E-2
81	Thallium-198 ²	D, all compounds	3E-4	5E-4	2E-5	8E-8	4E-4	4E-3
81	Thallium-198	D, all compounds	2E-4	3E-4	1E-5	5E-8	1E-4	3E-3
81	Thallium-199	D, all compounds	6E-4	8E-4	4E-5	1E-7	9E-4	9E-3
81	Thallium-200	D, all compounds	8E-3	1E-4	5E-6	2E-8	1E-4	3E-3
81	Thallium-201	D, all compounds	2E-4	2E-4	9E-6	1E-8	2E-4	2E-3
81	Thallium-202	D, all compounds	4E-3	5E-3	2E-6	7E-9	5E-5	5E-4
81	Thallium-204	D, all compounds	2E-3	2E-3	9E-7	3E-9	2E-5	2E-4
82	Lead-195 ²	D, all compounds	6E-4	2E-5	8E-5	3E-7	8E-4	8E-3
82	Lead-198	D, all compounds	3E-4	6E-4	3E-5	9E-8	4E-4	4E-3
82	Lead-199 ²	D, all compounds	2E-4	7E-4	3E-5	1E-7	3E-4	3E-3
82	Lead-200	D, all compounds	3E-3	6E-3	3E-6	9E-9	4E-5	4E-4
82	Lead-201	D, all compounds	7E-3	2E-4	8E-6	3E-8	1E-4	1E-3
82	Lead-202m	D, all compounds	9E-3	3E-4	1E-5	4E-8	1E-4	1E-3
82	Lead-202	D, all compounds	1E-2	5E-1	2E-8	7E-11	2E-6	2E-5
82	Lead-203	D, all compounds	5E-3	9E-3	4E-6	1E-8	7E-5	3E-4
82	Lead-205	D, all compounds	4E-3	1E-3	6E-7	2E-9	5E-5	9E-4
82	Lead-209	D, all compounds	2E-4	6E-4	2E-5	8E-8	3E-4	3E-3
82	Lead-218	D, all compounds	6E-1 Bone surf (1E-0)	2E-1 Bone surf (4E-1)	1E-10	-	-	-
82	Lead-211 ²	D, all compounds	1E-4	6E-2	3E-7	9E-10	2E-4	2E-3
82	Lead-212	D, all compounds	8E-1 Bone surf (1E-2)	3E-1	1E-8	9E-11	-	-
82	Lead-214 ²	D, all compounds	9E-3	8E-2	3E-7	1E-9	1E-4	1E-3
83	Bismuth-200 ²	D, nitrates W, all other compounds	3E-4	8E-4 1E-5	4E-5 4E-5	3E-7 1E-7	4E-4 -	9E-3 -
83	Bismuth-201 ²	D, see 200 ₈₁ W, see 200 ₈₁	1E-4 -	3E-4 4E-4	1E-5 2E-5	4E-8 5E-8	2E-4 -	2E-3 -
83	Bismuth-202 ²	D, see 200 ₈₁ W, see 200 ₈₁	1E-4 -	4E-4 8E-4	2E-5 3E-5	6E-8 1E-7	2E-4 -	2E-3 -

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 ALL (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
83	Bismuth-203	D, see 200 Bi W, see 200 Bi	2E+3 -	7E+3 6E+3	3E-6 3E-6	9E-9 9E-9	3E-5 -	3E-4 -
83	Bismuth-205	D, see 200 Bi W, see 200 Bi	1E+3 -	3E+3 1E+3	1E-6 5E-7	3E-9 2E-9	2E-5 -	2E-4 -
83	Bismuth-206	D, see 200 Bi W, see 200 Bi	6E+2 -	1E+3 9E+2	6E-7 4E-7	2E-9 1E-9	9E-6 -	9E-5 -
83	Bismuth-207	D, see 200 Bi W, see 200 Bi	1E+3 -	2E+3 4E+2	7E-7 1E-7	2E-9 5E-10	1E-5 -	2E-4 -
83	Bismuth-210a	D, see 200 Bi W, see 200 Bi	4E+1 Kidneys (6E+1)	5E+0 Kidneys (6E+0) 7E-1	2E-9 -	- 9E-12 9E-13	- 8E-7 -	- 8E-6 -
83	Bismuth-210	D, see 200 Bi W, see 200 Bi	8E+2 -	2E+2 Kidneys (4E+2) 3E+1	1E-7 -	- 5E-10 4E-11	1E-5 -	1E-4 -
83	Bismuth-212 ²	D, see 200 Bi W, see 200 Bi	5E+3 -	2E+2 3E+2	1E-7 1E-7	3E-10 4E-10	7E-5 -	7E-4 -
83	Bismuth-213 ²	D, see 200 Bi W, see 200 Bi	7E+3 -	3E+2 4E+2	1E-7 1E-7	4E-10 5E-10	1E-4 -	1E-3 -
83	Bismuth-214 ²	D, see 200 Bi W, see 200 Bi	2E+4 SL, wall (2E+4) -	6E+2 -	3E-7 -	1E-9 -	- 3E-4	- 3E-3
84	Polonium-203 ²	D, all compounds except those given for W W, oxides, hydroxides, and nitrates	3E+4 -	6E+4 9E+4	3E-5 4E-5	9E-8 1E-7	3E-4 -	3E-3 -
84	Polonium-205 ²	D, see 203 Po W, see 203 Po	2E+4 -	4E+4 7E+4	2E-5 3E-5	5E-8 1E-7	3E-4 -	3E-3 -
84	Polonium-207	D, see 203 Po W, see 203 Po	8E+3 -	3E+4 3E+4	1E-5 1E-5	3E-8 4E-8	1E-4 -	1E-3 -
84	Polonium-210	D, see 203 Po W, see 203 Po	3E+0 -	6E-1 6E-1	3E-10 3E-10	9E-13 9E-13	4E-8 -	4E-7 -
85	Astatine-207 ²	D, halides W	6E+3 -	2E+3 2E+3	1E-6 9E-7	4E-9 3E-9	8E-5 -	8E-4 -
85	Astatine-211	D, halides W	1E+2 -	8E+1 5E+1	3E-8 2E-8	1E-10 8E-11	2E-6 -	2E-5 -
86	Radon-220	With daughters removed With daughters present	- -	2E+4 2E+1 (or 12 working level months)	7E-6 9E-9 (or 1.0 working level)	2E-8 3E-11 -	- -	- -

Atomic Radionuclide No.	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
		Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
			Col. 2 ALI (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
86	Radon-222	With daughters removed With daughters present	- - 1E+4 (or 4 working level months)	4E-6 3E-8 (or 0.33 working level)	1E-8 1E-10	- -	- -
87	Francium-223 ²	O, all compounds	2E+3	5E+2	2E-7	6E-10	3E-5
87	Francium-223 ²	O, all compounds	6E+2	8E+2	3E-7	1E-9	8E-6
88	Radium-223	W, all compounds	3E+0 Bone surf (9E+0)	7E-1	3E-10	9E-13	-
88	Radium-224	W, all compounds	8E+0 Bone surf (2E+1)	2E+0	7E-10	2E-12	-
88	Radium-225	W, all compounds	8E+0 Bone surf (2E+1)	7E-1	3E-10	9E-13	-
88	Radium-226	W, all compounds	2E+0 Bone surf (5E+0)	6E-1	3E-10	9E-13	-
88	Radium-227 ²	W, all compounds	2E+4 Bone surf (2E+4)	1E+4 Bone surf (2E+4)	6E-6	-	-
88	Radium-228	W, all compounds	2E+0 Bone surf (4E+0)	1E+0	5E-10	2E-12	-
89	Actinium-224	O, all compounds except those given for W and Y	2E+3 LLI wall (2E+3)	3E+1 Bone surf (4E+1)	1E-8	-	-
	W, halides and nitrates	-	5E+1	2E-8	7E-11	-	-
	Y, oxides and hydroxides	-	5E+1	2E-8	6E-11	-	-
89	Actinium-225	O, see ²²⁴ Ac	5E+1 LLI wall (5E+1)	3E-1 Bone surf (5E-1)	1E-10	-	-
	W, see ²²⁴ Ac	-	6E-1	3E-10	7E-13	7E-7	7E-6
	Y, see ²²⁴ Ac	-	6E-1	3E-10	9E-13	-	-
89	Actinium-226	O, see ²²⁴ Ac	1E+2 LLI wall (1E+2)	3E+0 Bone surf (4E+0)	1E-9	-	-
	W, see ²²⁴ Ac	-	5E+0	2E-9	5E-12	2E-6	2E-5
	Y, see ²²⁴ Ac	-	5E+0	2E-9	7E-12	-	-
89	Actinium-227	O, see ²²⁴ Ac	2E-1 Bone surf (4E-1)	4E-4 Bone surf (8E-4)	2E-13	-	-
	W, see ²²⁴ Ac	-	2E-3	7E-13	1E-15	5E-9	5E-8
	Y, see ²²⁴ Ac	-	4E-3	2E-12	4E-15	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Inhalation		Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
				Col. 2 ALI (μ Ci)	Col. 3 DAC (μ Ci/ml)			
89	Actinium-228	D, see ^{224}Ac	2E+3	9E+0 Bone surf	4E-9	-	3E-5	3E-4
		W, see ^{224}Ac	-	(2E+1) 4E+1	-	2E-11	-	-
		Y, see ^{224}Ac	-	(6E+1) 4E+1	-	8E-11 6E-11	-	-
90	Thorium-226 ²	W, all compounds except those given for Y	5E+3 St. wall (5E+3)	2E+2	6E-8	2E-10	-	-
		Y, oxides and hydroxides	-	1E+2	6E-8	2E-10	-	-
90	Thorium-227	W, see ^{226}Th	1E+2	3E-1	1E-10	5E-13	2E-6	2E-5
		Y, see ^{226}Th	-	3E-1	1E-10	5E-13	-	-
90	Thorium-228	W, see ^{226}Th	6E+0 Bone surf (1E+1)	1E-2 Bone surf (2E-2)	4E-12	-	-	-
		Y, see ^{226}Th	-	2E-2	7E-12	3E-14 2E-14	2E-7	2E-6
90	Thorium-229	W, see ^{226}Th	6E-1 Bone surf (1E+0)	9E-4 Bone surf (2E-3)	4E-13	-	-	-
		Y, see ^{226}Th	-	2E-3 Bone surf (3E-3)	1E-12	3E-15	2E-8	2E-7
90	Thorium-230	W, see ^{226}Th	4E+0 Bone surf (9E+0)	6E-3 Bone surf (2E-2)	3E-12	-	-	-
		Y, see ^{226}Th	-	2E-2 Bone surf (2E-2)	6E-12	2E-14	1E-7	1E-6
90	Thorium-231	W, see ^{226}Th	4E+3	6E+3	3E-6	9E-9	5E-5	5E-4
		Y, see ^{226}Th	-	6E+3	3E-6	9E-9	-	-
90	Thorium-232	W, see ^{226}Th	7E-1 Bone surf (2E+0)	1E-3 Bone surf (3E-3)	5E-13	-	-	-
		Y, see ^{226}Th	-	3E-3 Bone surf (4E-3)	1E-12	4E-15	3E-8	3E-7
90	Thorium-234	W, see ^{226}Th	3E+2 LLL wall (4E+2)	2E+2	8E-8	3E-10	-	-
		Y, see ^{226}Th	-	2E+2	6E-8	2E-10	5E-6	5E-5
91	Protactinium-227 ²	W, all compounds except those given for Y	4E+3	1E+2	5E-8	2E-10	5E-5	5E-4
		Y, oxides and hydroxides	-	1E+2	4E-8	1E-10	-	-
91	Protactinium-228	W, see ^{227}Pa	1E+3	1E+1 Bone surf (2E+1)	5E-9	-	2E-5	2E-4
		Y, see ^{226}Pa	-	1E+1	5E-9	3E-11 2E-11	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 ALI (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
91	Protactinium-230	W, see 227Pa	6E+2 Bone surf (9E+2)	5E+0	2E-9	7E-12	-	-
		Y, see 227Pa	-	4E+0	1E-9	5E-12	1E-5	1E-4
91	Protactinium-231	W, see 227Pa	2E-1 Bone surf (5E-1)	2E-3 Bone surf (4E-3)	6E-13	-	-	-
		Y, see 226Pa	-	4E-3 Bone surf (6E-3)	2E-12	6E-15	6E-9	6E-8
			-	-	8E-15	-	-	-
91	Protactinium-232	W, see 227Pa	1E+3	2E+1 Bone surf (6E+1)	9E-9	-	2E-5	2E-4
		Y, see 227Pa	-	6E+1 Bone surf (7E+1)	2E-8	8E-11	-	-
			-	-	1E-10	-	-	-
91	Protactinium-233	W, see 227Pa	1E+3 LLI wall (2E+3)	7E+2	3E-7	1E-9	-	-
		Y, see 227Pa	-	6E+2	2E-7	8E-10	2E-5	2E-4
91	Protactinium-234	W, see 227Pa	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		Y, see 227Pa	-	7E+3	3E-6	9E-9	-	-
92	Uranium-230	D, Uf_6 , UO_2F_2 , $\text{UO}_2(\text{NO}_3)_2$	4E+0 Bone surf (6E+0)	4E-1 Bone surf (6E-1)	2E-10	-	-	-
		W, UO_3 , Uf_6 , UCl_4	-	4E-1	1E-10	8E-13	8E-8	8E-7
		Y, UO_2 , U_3O_8	-	3E-1	1E-10	4E-13	-	-
92	Uranium-231	D, see 230U	5E+3 LLI wall (4E+3)	8E+3	3E-6	1E-8	-	-
		W, see 230U	-	6E+3	2E-6	8E-9	6E-5	6E-4
		Y, see 230U	-	5E+3	2E-6	6E-9	-	-
92	Uranium-232	D, see 230U	2E+0 Bone surf (4E+0)	2E-1 Bone surf (4E-1)	9E-11	-	-	-
		W, see 230U	-	4E-1	2E-10	6E-13	6E-8	6E-7
		Y, see 230U	-	8E-3	3E-12	1E-14	-	-
92	Uranium-233	D, see 230U	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	5E-10	-	-	-
		W, see 230U	-	7E-1	3E-10	3E-12	3E-7	3E-6
		Y, see 230U	-	4E-2	2E-11	1E-12	-	-
			-	-	5E-14	-	-	-
92	Uranium-234 ³	D, see 230U	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	5E-10	-	-	-
		W, see 230U	-	7E-1	3E-10	3E-12	3E-7	3E-6
		Y, see 230U	-	4E-2	2E-11	1E-12	-	-
			-	-	5E-14	-	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μ Ci)	Inhalation		Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
				Col. 2 ALI (μ Ci)	Col. 3 DAC (μ Ci/ml)			
92	Uranium-235 ³	D, see 230U	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	6E-10	-	-	-
		W, see 230U	-	8E-1	3E-10	3E-12	3E-7	3E-6
		V, see 230U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-236	D, see 230U	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	5E-10	-	-	-
		W, see 230U	-	8E-1	3E-10	3E-12	3E-7	3E-6
		V, see 230U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-237	D, see 230U	2E+3 LLI wall (2E+3)	3E+3	1E-6	4E-9	-	-
		W, see 230U	-	2E+3	7E-7	2E-9	3E-5	3E-4
		V, see 230U	-	2E+3	6E-7	2E-9	-	-
92	Uranium-238 ³	D, see 230U	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	6E-10	-	-	-
		W, see 230U	-	8E-1	3E-10	3E-12	3E-7	3E-6
		V, see 230U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-239 ²	D, see 230U	7E+4	2E+5	8E-5	3E-7	9E-4	9E-3
		W, see 230U	-	2E+5	7E-5	2E-7	-	-
		V, see 230U	-	2E+5	6E-5	2E-7	-	-
92	Uranium-240	D, see 230U	1E+3	4E+3	2E-6	5E-9	2E-5	2E-4
		W, see 230U	-	3E+3	1E-6	4E-9	-	-
		V, see 230U	-	2E+3	1E-6	3E-9	-	-
92	Uranium-natural ³	D, see 230U	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	5E-10	-	-	-
		W, see 230U	-	8E-1	3E-10	3E-12	3E-7	3E-6
		V, see 230U	-	5E-2	2E-11	9E-14	-	-
93	Neptunium-237 ²	W, all compounds	1E+5	2E+3 Bone surf (5E+2)	7E-7	-	2E-3	2E-2
			-	-	-	6E-9	-	-
93	Neptunium-237 ²	W, all compounds	8E+5	3E+6	1E-3	4E-6	1E-2	1E-1
93	Neptunium-234	W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
93	Neptunium-235	W, all compounds	2E+4 LLI wall (2E+4)	8E+2 Bone surf (1E+3)	3E-7	-	-	-
			-	-	-	2E-9	3E-4	3E-3
93	Neptunium-236 (1.15E+5 y)	W, all compounds	3E+0 Bone surf (6E+0)	2E-2 Bone surf (5E-2)	9E-12	-	-	-
			-	-	-	8E-14	9E-8	9E-7
93	Neptunium-236a (22.5 h)	W, all compounds	3E+3 Bone surf (4E+3)	3E+1 Bone surf (7E+1)	1E-8	-	-	-
			-	-	-	1E-10	5E-5	5E-4
93	Neptunium-237	W, all compounds	5E-1 Bone surf (1E+0)	4E-3 Bone surf (1E-2)	2E-12	-	-	-
			-	-	-	1E-14	2E-8	2E-7

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases To Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{m}^3$)	Col. 2 Water ($\mu\text{Ci}/\text{m}^3$)	Monthly Average Concentration ($\mu\text{Ci}/\text{m}^3$)
				Col. 2 All (μCi)	Col. 3 DCL ($\mu\text{Ci}/\text{m}^3$)			
93	Neptunium-238	V, all compounds	1E+3	6E+1 Bone surf (2E+2)	3E+8	-	2E+5	2E+4
93	Neptunium-239	V, all compounds	2E+3 LLI wall (2E+3)	2E+3	9E+7	3E+9	-	-
93	Neptunium-240 ²	V, all compounds	2E+4	8E+4	3E+5	1E+7	3E+4	3E+3
94	Plutonium-234	V, all compounds except PuO ₂ Y, PuO ₂	8E+3	2E+2 2E+2	9E+8 8E+8	3E+10 3E+10	1E+4	1E+3
94	Plutonium-235 ²	V, see ²³⁴ Pu Y, see ²³⁴ Pu	9E+5	3E+6 3E+6	1E+3 1E+3	4E+6 3E+6	1E+2	1E+1
94	Plutonium-236	V, see ²³⁴ Pu	2E+0 Bone surf (4E+0)	2E+2 Bone surf (4E+2)	8E+12	-	-	-
94	Plutonium-237	V, see ²³⁴ Pu Y, see ²³⁴ Pu	1E+4	3E+3 3E+3	1E+6 1E+6	9E+9 4E+9	2E+4	2E+3
94	Plutonium-238	V, see ²³⁴ Pu Y, see ²³⁴ Pu	9E+1 Bone surf (2E+0)	7E+3 Bone surf (1E+2) 2E+2	3E+12	-	-	-
94	Plutonium-239	V, see ²³⁴ Pu Y, see ²³⁴ Pu	8E+1 Bone surf (1E+0)	6E+3 Bone surf (1E+2) 2E+2 Bone surf (2E+2)	3E+12	-	-	-
94	Plutonium-240	V, see ²³⁴ Pu Y, see ²³⁴ Pu	8E+1 Bone surf (1E+0)	6E+3 Bone surf (1E+2) 2E+2 Bone surf (2E+2)	3E+12	-	-	-
94	Plutonium-241	V, see ²³⁴ Pu Y, see ²³⁴ Pu	4E+1 Bone surf (7E+1)	3E+1 Bone surf (8E+1) 8E+1 Bone surf (1E+0)	1E+10	-	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average... Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 ALI (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
94	Plutonium-242	W, see ^{234}Pu	8E-1 Bone surf (1E+0)	7E-3 Bone surf (1E-2)	3E-12	-	-	-
		Y, see ^{234}Pu	-	2E-2 Bone surf (2E-2)	7E-12	2E-14	2E-8	2E-7
94	Plutonium-243	W, see ^{234}Pu	2E+4	4E+4	2E-5	5E-8	2E-4	2E-3
		Y, see ^{234}Pu	-	4E+4	2E-5	5E-8	-	-
94	Plutonium-244	W, see ^{234}Pu	8E-1 Bone surf (2E+0)	7E-3 Bone surf (1E-2)	3E-12	-	-	-
		Y, see ^{234}Pu	-	2E-2 Bone surf (2E-2)	7E-12	2E-14	2E-8	2E-7
94	Plutonium-245	W, see ^{234}Pu	2E+3	5E+3	2E-6	6E-9	3E-5	3E-4
		Y, see ^{234}Pu	-	4E+3	2E-6	6E-9	-	-
94	Plutonium-246	W, see ^{234}Pu	4E+2 St. wall (4E+2)	3E+2	1E-7	4E-10	-	-
		Y, see ^{234}Pu	-	3E+2	1E-7	4E-10	6E-6	6E-5
95	Americium-237 ²	W, all compounds	8E+4	3E+5	1E-4	4E-7	1E-3	1E-2
95	Americium-238 ²	W, all compounds	4E+4	3E+3 Bone surf (6E+3)	1E-6	-	5E-4	5E-3
95	Americium-239	W, all compounds	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
95	Americium-240	W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
95	Americium-241	W, all compounds	8E-1 Bone surf (1E+0)	6E-3 Bone surf (1E-2)	3E-12	-	-	-
95	Americium-242m	W, all compounds	8E-1 Bone surf (1E+0)	6E-3 Bone surf (1E-2)	3E-12	-	-	-
			-	2E-2 Bone surf (2E-2)	-	2E-14	2E-8	2E-7
95	Americium-242	W, all compounds	4E+3	8E+1 Bone surf (9E+1)	4E-8	-	5E-5	5E-4
			-	-	-	1E-10	-	-
95	Americium-243	W, all compounds	8E-1 Bone surf (1E+0)	6E-3 Bone surf (1E-2)	3E-12	-	-	-
			-	2E-2 Bone surf (3E-2)	-	2E-14	2E-8	2E-7
95	Americium-244a ²	W, all compounds	6E+4 St. wall (8E+4)	4E+3 Bone surf (7E+3)	2E-6	-	-	-
95	Americium-244	W, all compounds	3E+3	2E+2 Bone surf (3E+2)	8E-8	-	4E-5	4E-4
95	Americium-245	W, all compounds	3E+4	8E+4	3E-5	1E-7	4E-8	4E-3

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 ALI (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)			
95	Americium-246 ²	W, all compounds	5E+4 St. wall (6E+4)	2E+5	8E-5	3E-7	-	-
95	Americium-246 ²	W, all compounds	3E+4	1E+5	4E-5	1E-7	8E-4	8E-3
96	Curium-238	W, all compounds	2E+4	1E+3	5E-7	2E-9	2E-4	2E-3
96	Curium-240	W, all compounds	6E+1 Bone surf (8E+1)	6E-1 Bone surf (6E-1)	2E-10	-	-	-
96	Curium-241	W, all compounds	1E+3	3E+1 Bone surf (4E+1)	1E-8	-	2E-5	2E-4
96	Curium-242	W, all compounds	3E+1 Bone surf (5E+1)	3E-1 Bone surf (3E-1)	1E-10	-	-	-
96	Curium-243	W, all compounds	1E+0 Bone surf (2E+0)	9E-3 Bone surf (2E-2)	4E-12	-	-	-
96	Curium-244	W, all compounds	1E+0 Bone surf (3E+0)	1E-2 Bone surf (2E-2)	5E-12	-	-	-
96	Curium-245	W, all compounds	7E-1 Bone surf (1E+0)	6E-3 Bone surf (1E-2)	3E-12	-	-	-
96	Curium-246	W, all compounds	7E-1 Bone surf (1E+0)	6E-3 Bone surf (1E-2)	3E-12	-	-	-
96	Curium-247	W, all compounds	8E-1 Bone surf (1E+0)	6E-3 Bone surf (1E-2)	3E-12	-	-	-
96	Curium-248	W, all compounds	2E-1 Bone surf (4E-1)	2E-3 Bone surf (3E-3)	7E-13	-	-	-
96	Curium-249 ²	W, all compounds	5E+4	2E+4 Bone surf (3E+4)	7E-6	-	7E-4	7E-3
96	Curium-250	W, all compounds	4E-2 Bone surf (6E-2)	3E-4 Bone surf (5E-4)	1E-13	-	-	-
97	Berkelium-245	W, all compounds	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
97	Berkelium-246	W, all compounds	3E+3	3E+3	1E-6	4E-9	4E-5	4E-4
97	Berkelium-247	W, all compounds	5E-1 Bone surf (1E+0)	4E-3 Bone surf (9E-3)	2E-12	-	-	-
97	Berkelium-249	W, all compounds	2E+2 Bone surf (5E+2)	2E+0 Bone surf (4E+0)	7E-10	-	-	-

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (μCi)	Inhalation		Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
				Col. 2 ALI (μCi)	Col. 3 ALI ($\mu\text{Ci}/\text{ml}$)			
97	Berkelium-250	W, all compounds	$9\text{E}+3$ -	$3\text{E}+2$ Bone surf ($7\text{E}+2$)	$1\text{E}-7$ -	- $1\text{E}-9$	$1\text{E}-4$ -	$2\text{E}-3$ -
98	Californium-244 ²	W, all compounds except those given for Y	$3\text{E}+4$ St. wall ($3\text{E}+4$)	$6\text{E}+2$ -	$2\text{E}-7$ -	$8\text{E}-10$ -	- $4\text{E}-4$	- $4\text{E}-3$
		Y, oxides and hydrazides	-	$6\text{E}+2$	$2\text{E}-7$	$8\text{E}-10$	-	-
98	Californium-246	W, see ²⁴⁴ Cf Y, see ²⁴⁴ Cf	$4\text{E}+2$ -	$9\text{E}+0$ $9\text{E}+0$	$4\text{E}-9$ $4\text{E}-9$	$1\text{E}-11$ $1\text{E}-11$	$5\text{E}-6$ -	$5\text{E}-5$ -
98	Californium-248	W, see ²⁴⁴ Cf Y, see ²⁴⁴ Cf	$8\text{E}+0$ Bone surf ($2\text{E}+1$) -	$6\text{E}-2$ Bone surf ($1\text{E}-1$) $1\text{E}-1$	$3\text{E}-11$ - $4\text{E}-11$	- $2\text{E}-13$ $1\text{E}-13$	- $2\text{E}-7$ -	- $2\text{E}-6$ -
98	Californium-249	W, see ²⁴⁴ Cf Y, see ²⁴⁴ Cf	$5\text{E}-1$ Bone surf ($1\text{E}+0$) -	$4\text{E}-3$ Bone surf ($9\text{E}-3$) $1\text{E}-2$ Bone surf ($1\text{E}-2$)	$2\text{E}-12$ - $4\text{E}-12$ -	- $1\text{E}-14$ -	- $2\text{E}-8$ -	- $2\text{E}-7$ -
98	Californium-250	W, see ²⁴⁴ Cf Y, see ²⁴⁴ Cf	$1\text{E}+0$ Bone surf ($2\text{E}+0$) -	$9\text{E}-3$ Bone surf ($2\text{E}-2$) $3\text{E}-2$	$4\text{E}-12$ - $1\text{E}-11$	- $3\text{E}-14$ $4\text{E}-14$	- $3\text{E}-8$ -	- $3\text{E}-7$ -
98	Californium-251	W, see ²⁴⁴ Cf Y, see ²⁴⁴ Cf	$5\text{E}-1$ Bone surf ($1\text{E}+0$) -	$4\text{E}-3$ Bone surf ($9\text{E}-3$) $1\text{E}-2$ Bone surf ($1\text{E}-2$)	$2\text{E}-12$ - $4\text{E}-12$ -	- $1\text{E}-14$ -	- $2\text{E}-8$ -	- $2\text{E}-7$ -
98	Californium-252	W, see ²⁴⁴ Cf Y, see ²⁴⁴ Cf	$2\text{E}+0$ Bone surf ($5\text{E}+0$) -	$2\text{E}-2$ Bone surf ($4\text{E}-2$) $3\text{E}-2$	$8\text{E}-12$ - $1\text{E}-11$	- $5\text{E}-14$ $5\text{E}-14$	- $7\text{E}-8$ -	- $2\text{E}-7$ -
98	Californium-253	W, see ²⁴⁴ Cf Y, see ²⁴⁴ Cf	$2\text{E}+2$ Bone surf ($4\text{E}+2$) -	$2\text{E}+0$ - $2\text{E}+0$	$8\text{E}-10$ - $7\text{E}-10$	$3\text{E}-12$ - $2\text{E}-12$	- $5\text{E}-6$ -	- $5\text{E}-5$ -
98	Californium-254	W, see ²⁴⁴ Cf Y, see ²⁴⁴ Cf	$2\text{E}+0$ -	$2\text{E}-2$ $2\text{E}-2$	$9\text{E}-12$ $7\text{E}-12$	$3\text{E}-14$ $2\text{E}-14$	$3\text{E}-8$ -	$3\text{E}-7$ -
99	Einsteinium-250	W, all compounds	$4\text{E}+4$ -	$5\text{E}+2$ Bone surf ($1\text{E}+3$)	$2\text{E}-7$ -	- $2\text{E}-9$	$6\text{E}-4$ -	$6\text{E}-3$ -
99	Einsteinium-251	W, all compounds	$7\text{E}+3$ -	$9\text{E}+2$ Bone surf ($1\text{E}+3$)	$4\text{E}-7$ -	- $2\text{E}-9$	$1\text{E}-4$ -	$1\text{E}-3$ -
99	Einsteinium-253	W, all compounds	$2\text{E}+2$	$1\text{E}+0$	$6\text{E}-10$	$2\text{E}-12$	$2\text{E}-6$	$2\text{E}-5$

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
			Col. 1 Oral Ingestion ALI (rCi)	Col. 2	Col. 3	Col. 1	Col. 2	Monthly Average Concentration (μ Ci/ml)
				Inhalation All (μ Ci)	DL (μ Ci/ml)	Air (μ Ci/ml)	Water (μ Ci/ml)	
99	Einsteinium-254m	W, all compounds	3E+2 [LI wall (3E+2)]	1E+1	4E+9	1E-11	-	-
99	Einsteinium-254	W, all compounds	8E+0 Bone surf (2E+1)	7E-2 Bone surf (1E-1)	5E-11	-	-	-
100	Fermium-252	W, all compounds	5E+2	1E+1	5E+9	2E-13	6E-6	6E-5
100	Fermium-253	W, all compounds	1E+3	1E+1	4E+9	1E-11	1E-5	1E-4
100	Fermium-254	W, all compounds	3E+3	9E+1	4E+8	1E-10	4E-5	4E-4
100	Fermium-255	W, all compounds	5E+2	2E+1	9E+9	3E-11	7E-6	7E-5
100	Fermium-257	W, all compounds	2E+1 Bone surf (4E+1)	2E-1 Bone surf (2E-1)	7E-11	-	-	-
101	Mendelevium-257	W, all compounds	7E+3	8E+1 Bone surf (9E+1)	4E+8	-	1E-4	1E-3
101	Mendelevium-258	W, all compounds	3E+1 Bone surf (5E+1)	2E-1 Bone surf (3E-1)	1E-10	-	-	-
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours			Subversion ¹	2E+2	1E-7	1E-9	-	-
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours			-	2E-1	1E-10	1E-12	1E-8	1E-7
Any single radionuclide not listed above that decays by alpha emission or spontaneous fission, or any mixture for which either the identity or the concentration of any radionuclide in the mixture is not known			-	4E-4	2E-13	1E-15	2E-9	2E-8

FOOTNOTES:

¹ "Submersion" means that values given are for submersion in a hemispherical semi-infinite cloud of airborne material.

² These radionuclides have radiological half-lives of less than 2 hours. The total effective dose equivalent received during operations with these radionuclides might include a significant contribution from external exposures. The DAC values for all radionuclides, other than those designated Class "Submersion," are based upon the committed effective dose equivalent due to the intake of the radionuclide into the body and do NOT include potentially significant contributions to dose equivalent from external exposures. The licensee may substitute 1E-7 $\mu\text{Ci}/\text{ml}$ for the listed DAC to account for the submersion dose prospectively, but should use individual monitoring devices or other radiation measuring instruments that measure external exposure to demonstrate compliance with the limits. (See § 20.1203.)

³ For soluble mixtures of U-238, U-234, and U-235 in air, chemical toxicity may be the limiting factor (see § 20.1201(e)). If the percent by weight (enrichment) of U-235 is not greater than 5, the concentration value for a 40-hour workweek is 0.2 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour workweek shall not exceed 8E-3 (SA) $\mu\text{Ci}\cdot\text{hr}/\text{ml}$, where SA is the specific activity of the uranium inhaled. The specific activity for natural uranium is 6.77E-7 curies per gram U. The specific activity for other mixtures of U-238, U-235, and U-234, if not known, shall be:

$$SA = 3.6E-7 \text{ curies/gram U} \quad \text{U-depleted}$$

$$SA = [0.4 + 0.38 (\text{enrichment}) + 0.0034 (\text{enrichment})^2] E-6, \text{ enrichment} \geq 0.72$$

where enrichment is the percentage by weight of U-235, expressed as percent.

NOTE:

- If the identity of each radionuclide in a mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture shall be the most restrictive DAC of any radionuclide in the mixture.
- If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in this appendix are not present in the mixture, the inhalation ALI, DAC, and effluent and sewage concentrations for the mixture are the lowest values specified in this appendix for any radionuclide that is not known to be absent from the mixture; or

Radionuclide	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
	Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC ($\mu\text{Ci}/\text{ml}$)	Col. 1 Air ($\mu\text{Ci}/\text{ml}$)	Col. 2 Water ($\mu\text{Ci}/\text{ml}$)	Monthly Average Concentration ($\mu\text{Ci}/\text{ml}$)
If it is known that Ac-227-D and Ca-250-W are not present	-	7E-4	3E-13	-	-	-
If, in addition, it is known that Ac-227-W,Y, Th-229-W,Y, Th-230-W, Th-232-W,Y, Pa-231-W,Y, Np-237-W, Pu-239-W, Pu-240-W, Pu-242-W, Am-241-W, Am-242m-W, Am-243-W, Cm-245-W, Cm-246-W, Cm-247-W, Cm-248-W, Bk-247-W, Cf-249-W, and Cf-251-W are not present	-	7E-3	3E-12	-	-	-
If, in addition, it is known that Sm-146-W, Sm-147-W, Gd-148-D,W, Gd-152-D,W, Th-228-W,Y, Th-230-Y, U-232-Y, U-233-Y, U-234-Y, U-235-Y, U-236-Y, U-238-Y, Np-236-W, Pu-236-W,Y, Pu-238-W,Y, Pu-239-Y, Pu-240-Y, Pu-242-Y, Pu-244-W,Y, Cm-243-W, Cm-244-W, Cf-248-W, Cf-249-Y, Cf-250-W,Y, Cf-251-Y, Cf-252-W,Y, and Cf-254-W,Y are not present	-	7E-2	3E-11	-	-	-
If, in addition, it is known that Pb-210-D, Bi-210-W, Po-210-D,W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D,W,Y, Th-227-W,Y, U-230-D,W,r, U-232-D,W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-Y, Es-254-W, Fm-257-W, and Md-258-W are not present	-	7E-1	3E-10	-	-	-

Radionuclide	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Releases to Sewers
	Col. 1 Oral Ingestion ALI (μ Ci)	Col. 2 Inhalation ALI (μ Ci)	Col. 3 DAC (μ Ci/ml)	Col. 1 Air (μ Ci/ml)	Col. 2 Water (μ Ci/ml)	Monthly Average Concentration (μ Ci/ml)
If, in addition, it is known that Si-32-Y, Ti-44-Y, Fe-60-D, Sr-90-Y, Zr-93-D, Cd-113m-D, Cd-113-D, In-115-D, W, Te-138-D, Lu-176-W, Hf-178m-D, W, Hf-182-D, W, Bi-210m-D, Ra-224-W, Ra-228-W, Ac-226-D, W, Y, Pa-230-W, Y, U-233-D, W, U-234-D, W, U-235-D, W, U-236-D, W, U-238-D, W, Pu-243-Y, Bk-249-W, Cf-253-W, Y, and Es-253-W are not present	-	7E-0	3E-9	-	-	-
If it is known that Ac-227-D, W, Y, Th-229-W, Y, Th-232-W, Y, Pa-231-W, Y, Cm-248-W, and Cm-250-W are not present -	-	-	-	1E-14	-	-
If, in addition, it is known that Sm-146-W, Gd-148-D, W, Gd-152-D, Th-228-W, Y, Th-230-W, Y, U-232-Y, U-233-Y, U-234-Y, U-235-Y, U-236-Y, U-238-Y, U-Nat-Y, Mo-236-W, Mo-237-W, Pu-236-W, Y, Pu-238-W, Y, Pu-239-W, Y, Pu-240-W, Y, Pu-242-W, Y, Pu-244-W, Y, Am-241-W, Am-242m-W, Am-243-W, Cm-243-W, Cm-244-W, Cm-245-W, Cm-246-W, Cm-247-W, Bk-247-W, Cf-249-W, Y, Cf-250-W, Y, Cf-251-W, Y, Cf-252-W, Y, and Cf-254-W, Y are not present	-	-	-	1E-13	-	-
If, in addition, it is known that Sm-147-W, Gd-152-W, Pb-210-D, Bi-210m-W, Po-210-D, W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D, W, Y, Th-227-W, Y, U-230-D, W, Y, U-232-D, W, U-Nat-W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-W, Y, Es-254-W, Fm-257-W, and Md-258-W are not present	-	-	-	1E-12	-	-
If, in addition it is known that Fe-60, Sr-90, Cd-113m, Cd-113, In-115, I-129, Cs-134, Sm-145, Sm-147, Gd-148, Gd-152, Mg-154 (organic), Bi-210m, Ra-223, Ra-224, Ra-225, Ac-225, Th-228, Th-230, U-233, U-234, U-235, U-236, U-238, U-Nat, Cm-242, Cf-248, Es-254, Fm-257, and Md-258 are not present	-	-	-	-	1E-6	1E-5

3 If a mixture of radionuclides consists of uranium and its daughters in ore dust (10 μ m AMAD particle distribution assumed) prior to chemical separation of the uranium from the ore, the following values may be used for the DAC of the mixture: 6E-11 μ Ci of gross alpha activity from uranium-238, uranium-234, thorium-230, and radium-226 per milliliter of air; 3E-11 μ Ci of natural uranium per milliliter of air; or 45 micrograms of natural uranium per cubic meter of air.

4 If the identity and concentration of each radionuclide in a mixture are known, the limiting values should be derived as follows: determine, for each radionuclide in the mixture, the ratio between the concentration present in the mixture and the concentration otherwise established in Appendix B for the specific radionuclide when not in a mixture. The sum of such ratios for all of the radionuclides in the mixture may not exceed "1" (i.e., "unity").

Example: If radionuclides "A," "B," and "C" are present in concentrations C_A , C_B , and C_C , and if the applicable DACs are DAC_A , DAC_B , and DAC_C , respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{DAC_A} + \frac{C_B}{DAC_B} + \frac{C_C}{DAC_C} < 1$$

[56 FR 23409, May 21, 1991; 56 FR 61352, Dec. 3, 1991]

APPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELINGAPPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELING—Continued

Radionuclide	Quantity (μCi)
Hydrogen-3	1,000
Beryllium-7	1,000
Beryllium-10	1
Carbon-11	1,000
Carbon-14	1,000
Fluorine-18	1,000
Sodium-22	10
Sodium-24	100
Magnesium-28	100
Aluminum-26	10
Silicon-31	1,000
Silicon-32	1
Phosphorus-32	10
Phosphorus-33	100
Sulfur-35	100
Chlorine-36	10
Chlorine-38	1,000
Chlorine-39	1,000
Argon-39	1,000
Argon-41	1,000
Potassium-40	100
Potassium-42	1,000
Potassium-43	1,000
Potassium-44	1,000
Potassium-45	1,000
Calcium-41	100
Calcium-45	100
Calcium-47	100
Scandium-43	1,000
Scandium-44m	100
Scandium-44	100
Scandium-46	10
Scandium-47	100
Scandium-48	100
Scandium-49	1,000
Titanium-44	1
Titanium-45	1,000
Vanadium-47	1,000
Vanadium-48	100
Vanadium-49	1,000
Chromium-48	1,000
Chromium-49	1,000
Chromium-51	1,000
Manganese-51	1,000
Manganese-52m	1,000
Manganese-52	100
Manganese-53	1,000
Manganese-54	100
Manganese-56	1,000
Iron-52	100
Iron-55	100
Iron-59	10
Iron-60	1
Cobalt-55	100
Cobalt-56	10
Cobalt-57	100
Cobalt-58m	1,000
Cobalt-58	100
Cobalt-60m	1,000
Cobalt-60	1
Cobalt-61	1,000
Cobalt-62m	1,000
Nickel-56	100
Nickel-57	100
Nickel-59	100

Radionuclide	Quantity (μCi)
Nickel-63	100
Nickel-65	1,000
Nickel-66	10
Copper-60	1,000
Copper-61	1,000
Copper-64	1,000
Copper-67	1,000
Zinc-62	100
Zinc-63	1,000
Zinc-65	10
Zinc-69m	100
Zinc-69	1,000
Zinc-71m	1,000
Zinc-72	100
Gallium-65	1,000
Gallium-66	100
Gallium-67	1,000
Gallium-68	1,000
Gallium-70	1,000
Gallium-72	100
Gallium-73	1,000
Germanium-66	1,000
Germanium-67	1,000
Germanium-68	10
Germanium-69	1,000
Germanium-71	1,000
Germanium-75	1,000
Germanium-77	1,000
Germanium-78	1,000
Arsenic-69	1,000
Arsenic-70	1,000
Arsenic-71	100
Arsenic-72	100
Arsenic-73	100
Arsenic-74	100
Arsenic-76	100
Arsenic-77	100
Arsenic-78	1,000
Selenium-70	1,000
Selenium-73m	1,000
Selenium-73	100
Selenium-75	100
Selenium-79	100
Selenium-81m	1,000
Selenium-81	1,000
Selenium-83	1,000
Bromine-74m	1,000
Bromine-74	1,000
Bromine-75	1,000
Bromine-76	100
Bromine-77	1,000
Bromine-80m	1,000
Bromine-80	1,000
Bromine-82	100
Bromine-83	1,000
Bromine-84	1,000
Krypton-74	1,000
Krypton-76	1,000
Krypton-77	1,000
Krypton-79	1,000
Krypton-81	1,000
Krypton-83m	1,000
Krypton-85m	1,000
Krypton-85	1,000
Krypton-87	1,000
Krypton-88	1,000
Rubidium-79	1,000

APPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELING—Continued

Radionuclide	Quantity (μ Ci)
Rubidium-81m	1,000
Rubidium-81	1,000
Rubidium-82m	1,000
Rubidium-83	100
Rubidium-84	100
Rubidium-86	100
Rubidium-87	100
Rubidium-88	1,000
Rubidium-89	1,000
Strontium-80	100
Strontium-81	1,000
Strontium-83	100
Strontium-85m	1,000
Strontium-85	100
Strontium-87m	1,000
Strontium-89	10
Strontium-90	0.1
Strontium-91	100
Strontium-92	100
Yttrium-86m	1,000
Yttrium-86	100
Yttrium-87	100
Yttrium-88	10
Yttrium-90m	1,000
Yttrium-90	10
Yttrium-91m	1,000
Yttrium-91	10
Yttrium-92	100
Yttrium-93	100
Yttrium-94	1,000
Yttrium-95	1,000
Zirconium-86	100
Zirconium-88	10
Zirconium-89	100
Zirconium-93	1
Zirconium-95	10
Zirconium-97	100
Niobium-88	1,000
Niobium-89m (66 min)	1,000
Niobium-89 (122 min)	1,000
Niobium-90	100
Niobium-93m	10
Niobium-94	1
Niobium-95m	100
Niobium-95	100
Niobium-96	100
Niobium-97	1,000
Niobium-98	1,000
Molybdenum-90	100
Molybdenum-93m	100
Molybdenum-93	10
Molybdenum-99	100
Molybdenum-101	1,000
Technetium-93m	1,000
Technetium-93	1,000
Technetium-94m	1,000
Technetium-94	1,000
Technetium-96m	1,000
Technetium-96	100
Technetium-97m	100
Technetium-97	1,000
Technetium-98	10
Technetium-99m	1,000
Technetium-99	100
Technetium-101	1,000
Technetium-104	1,000
Ruthenium-94	1,000

APPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELING—Continued

Radionuclide	Quantity (μ Ci)
Ruthenium-97	1,000
Ruthenium-103	100
Ruthenium-105	1,000
Ruthenium-106	1
Rhodium-99m	1,000
Rhodium-99	100
Rhodium-100	100
Rhodium-101m	1,000
Rhodium-101	10
Rhodium-102m	10
Rhodium-102	10
Rhodium-103m	1,000
Rhodium-105	100
Rhodium-106m	1,000
Rhodium-107	1,000
Palladium-100	100
Palladium-101	1,000
Palladium-103	100
Palladium-107	10
Palladium-109	100
Silver-102	1,000
Silver-103	1,000
Silver-104m	1,000
Silver-104	1,000
Silver-105	100
Silver-106m	100
Silver-106	1,000
Silver-108m	1
Silver-110m	10
Silver-111	100
Silver-112	100
Silver-115	1,000
Cadmium-104	1,000
Cadmium-107	1,000
Cadmium-109	1
Cadmium-113m	0.1
Cadmium-113	100
Cadmium-115m	10
Cadmium-115	100
Cadmium-117m	1,000
Cadmium-117	1,000
Indium-109	1,000
Indium-110 (69.1 min.)	1,000
Indium-110 (4.9h)	1,000
Indium-111	100
Indium-112	1,000
Indium-113m	1,000
Indium-114m	10
Indium-115m	1,000
Indium-115	100
Indium-116m	1,000
Indium-117m	1,000
Indium-117	1,000
Indium-119m	1,000
Tin-110	100
Tin-111	1,000
Tin-113	100
Tin-117m	100
Tin-119m	100
Tin-121m	100
Tin-121	1,000
Tin-123m	1,000
Tin-123	10
Tin-125	10
Tin-126	10
Tin-127	1,000

Nuclear Regulatory Commission

APPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELING—Continued

Radionuclide	Quantity (μCi)
Tin-128	1,000
Antimony-115	1,000
Antimony-116m	1,000
Antimony-116	1,000
Antimony-117	1,000
Antimony-118m	1,000
Antimony-119	1,000
Antimony-120 (16min.)	1,000
Antimony-120 (5.76d)	100
Antimony-122	100
Antimony-124m	1,000
Antimony-124	10
Antimony-125	100
Antimony-126m	1,000
Antimony-126	100
Antimony-127	100
Antimony-128 (10.4min.)	1,000
Antimony-128 (9.01h)	100
Antimony-129	100
Antimony-130	1,000
Antimony-131	1,000
Tellurium-116	1,000
Tellurium-121m	10
Tellurium-121	100
Tellurium-123m	10
Tellurium-123	100
Tellurium-125m	10
Tellurium-127m	10
Tellurium-127	1,000
Tellurium-129m	10
Tellurium-129	1,000
Tellurium-131m	10
Tellurium-131	100
Tellurium-132	10
Tellurium-133m	100
Tellurium-133	1,000
Tellurium-134	1,000
Iodine-120m	1,000
Iodine-120	100
Iodine-121	1,000
Iodine-123	100
Iodine-124	10
Iodine-125	1
Iodine-126	1
Iodine-128	1,000
Iodine-129	1
Iodine-130	10
Iodine-131	1
Iodine-132m	100
Iodine-132	100
Iodine-133	10
Iodine-134	1,000
Iodine-135	100
Xenon-120	1,000
Xenon-121	1,000
Xenon-122	1,000
Xenon-123	1,000
Xenon-125	1,000
Xenon-127	1,000
Xenon-129m	1,000
Xenon-131m	1,000
Xenon-133m	1,000
Xenon-133	1,000
Xenon-135m	1,000
Xenon-135	1,000
Xenon-138	1,000
Cesium-125	1,000

Pt. 20 [§§ 20.1001—20.2401], App. C

APPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELING—Continued

Radionuclide	Quantity (μCi)
Cesium-127	1,000
Cesium-129	1,000
Cesium-130	1,000
Cesium-131	1,000
Cesium-132	100
Cesium-134m	1,000
Cesium-134	10
Cesium-135m	1,000
Cesium-135	100
Cesium-136	10
Cesium-137	10
Cesium-138	1,000
Barium-126	1,000
Barium-128	100
Barium-131m	1,000
Barium-131	100
Barium-133m	100
Barium-133	100
Barium-135m	100
Barium-139	1,000
Barium-140	100
Barium-141	1,000
Barium-142	1,000
Lanthanum-131	1,000
Lanthanum-132	100
Lanthanum-135	1,000
Lanthanum-137	10
Lanthanum-138	100
Lanthanum-140	100
Lanthanum-141	100
Lanthanum-142	1,000
Lanthanum-143	1,000
Cerium-134	100
Cerium-135	100
Cerium-137m	100
Cerium-137	1,000
Cerium-139	100
Cerium-141	100
Cerium-143	100
Cerium-144	1
Praseodymium-136	1,000
Praseodymium-137	1,000
Praseodymium-138m	1,000
Praseodymium-139	1,000
Praseodymium-142m	1,000
Praseodymium-142	100
Praseodymium-143	100
Praseodymium-144	1,000
Praseodymium-145	100
Praseodymium-147	1,000
Neodymium-136	1,000
Neodymium-138	100
Neodymium-139m	1,000
Neodymium-139	1,000
Neodymium-141	1,000
Neodymium-147	100
Neodymium-149	1,000
Neodymium-151	1,000
Promethium-141	1,000
Promethium-143	100
Promethium-144	10
Promethium-145	10
Promethium-146	1
Promethium-147	10
Promethium-148m	10
Promethium-148	10
Promethium-149	100

APPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELING—Continued

Radionuclide	Quantity (μ Ci)
Promethium-150	1,000
Promethium-151	100
Samarium-141m	1,000
Samarium-141	1,000
Samarium-142	1,000
Samarium-145	100
Samarium-146	1
Samarium-147	100
Samarium-151	10
Samarium-153	100
Samarium-155	1,000
Samarium-156	1,000
Europium-145	100
Europium-146	100
Europium-147	100
Europium-148	10
Europium-149	100
Europium-150 (12.62h)	100
Europium-150 (34.2y)	1
Europium-152m	100
Europium-152	1
Europium-154	1
Europium-155	10
Europium-156	100
Europium-157	100
Europium-158	1,000
Gadolinium-145	1,000
Gadolinium-146	10
Gadolinium-147	100
Gadolinium-148	0.001
Gadolinium-149	100
Gadolinium-151	10
Gadolinium-152	100
Gadolinium-153	10
Gadolinium-159	100
Terbium-147	1,000
Terbium-149	100
Terbium-150	1,000
Terbium-151	100
Terbium-153	1,000
Terbium-154	100
Terbium-155	1,000
Terbium-156m (5.0h)	1,000
Terbium-156m (24.4h)	1,000
Terbium-156	100
Terbium-157	10
Terbium-158	1
Terbium-160	10
Terbium-161	100
Dysprosium-155	1,000
Dysprosium-157	1,000
Dysprosium-159	100
Dysprosium-165	1,000
Dysprosium-166	100
Holmium-155	1,000
Holmium-157	1,000
Holmium-159	1,000
Holmium-161	1,000
Holmium-162m	1,000
Holmium-162	1,000
Holmium-164m	1,000
Holmium-164	1,000
Holmium-166m	1
Holmium-166	100
Holmium-167	1,000
Erbium-161	1,000
Erbium-165	1,000

APPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELING—Continued

Radionuclide	Quantity (μ Ci)
Erbium-169	100
Erbium-171	100
Erbium-172	100
Thulium-162	1,000
Thulium-166	100
Thulium-167	100
Thulium-170	10
Thulium-171	10
Thulium-172	100
Thulium-173	100
Thulium-175	1,000
Ytterbium-162	1,000
Ytterbium-166	100
Ytterbium-167	1,000
Ytterbium-169	100
Ytterbium-175	100
Ytterbium-177	1,000
Ytterbium-178	1,000
Lutetium-169	100
Lutetium-170	100
Lutetium-171	100
Lutetium-172	100
Lutetium-173	10
Lutetium-174m	10
Lutetium-174	10
Lutetium-176m	1,000
Lutetium-176	100
Lutetium-177m	10
Lutetium-177	100
Lutetium-178m	1,000
Lutetium-178	1,000
Lutetium-179	1,000
Hafnium-170	100
Hafnium-172	1
Hafnium-173	1,000
Hafnium-175	100
Hafnium-177m	1,000
Hafnium-178m	0.1
Hafnium-179m	10
Hafnium-180m	1,000
Hafnium-181	10
Hafnium-182m	1,000
Hafnium-182	0.1
Hafnium-183	1,000
Hafnium-184	100
Tantalum-172	1,000
Tantalum-173	1,000
Tantalum-174	1,000
Tantalum-175	1,000
Tantalum-176	100
Tantalum-177	1,000
Tantalum-178	1,000
Tantalum-179	100
Tantalum-180m	1,000
Tantalum-180	100
Tantalum-182m	1,000
Tantalum-182	10
Tantalum-183	100
Tantalum-184	100
Tantalum-185	1,000
Tantalum-186	1,000
Tungsten-176	1,000
Tungsten-177	1,000
Tungsten-178	1,000
Tungsten-179	1,000
Tungsten-181	1,000
Tungsten-185	100

Nuclear Regulatory Commission

Pt. 20 [§§ 20.1001—20.2401], App. C

APPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELING—Continued

APPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELING—Continued

Radionuclide	Quantity (μCi)
Tungsten-187.....	100
Tungsten-188.....	10
Rhenium-177.....	1,000
Rhenium-178.....	1,000
Rhenium-181.....	1,000
Rhenium-182 (12.7h).....	1,000
Rhenium-182 (64.0h).....	100
Rhenium-184m.....	10
Rhenium-184.....	100
Rhenium-186m.....	10
Rhenium-186.....	100
Rhenium-187.....	1,000
Rhenium-188m.....	1,000
Rhenium-188.....	100
Rhenium-189.....	100
Osmium-180.....	1,000
Osmium-181.....	1,000
Osmium-182.....	100
Osmium-185.....	100
Osmium-189m.....	1,000
Osmium-191m.....	1,000
Osmium-191.....	100
Osmium-193.....	100
Osmium-194.....	1
Iridium-182.....	1,000
Iridium-184.....	1,000
Iridium-185.....	1,000
Iridium-186.....	100
Iridium-187.....	1,000
Iridium-188.....	100
Iridium-189.....	100
Iridium-190m.....	1,000
Iridium-190.....	100
Iridium-192 (73.8d).....	1
Iridium-192m (1.4min).....	10
Iridium-194m.....	10
Iridium-194.....	100
Iridium-195m.....	1,000
Iridium-195.....	1,000
Platinum-186.....	1,000
Platinum-188.....	100
Platinum-189.....	1,000
Platinum-191.....	100
Platinum-193m.....	100
Platinum-193.....	1,000
Platinum-195m.....	100
Platinum-197m.....	1,000
Platinum-197.....	100
Platinum-199.....	1,000
Platinum-200.....	100
Gold-193.....	1,000
Gold-194.....	100
Gold-195.....	10
Gold-198m.....	100
Gold-198.....	100
Gold-199.....	100
Gold-200m.....	100
Gold-200.....	1,000
Gold-201.....	1,000
Mercury-193m.....	100
Mercury-193.....	1,000
Mercury-194.....	1
Mercury-195m.....	100
Mercury-195.....	1,000
Mercury-197m.....	100
Mercury-197.....	1,000
Mercury-199m.....	1,000

Radionuclide	Quantity (μCi)
Mercury-203.....	100
Thallium-194m.....	1,000
Thallium-194.....	1,000
Thallium-195.....	1,000
Thallium-197.....	1,000
Thallium-198m.....	1,000
Thallium-198.....	1,000
Thallium-199.....	1,000
Thallium-200.....	1,000
Thallium-201.....	1,000
Thallium-202.....	100
Thallium-204.....	100
Lead-195m.....	1,000
Lead-198.....	1,000
Lead-199.....	1,000
Lead-200.....	100
Lead-201.....	1,000
Lead-202m.....	1,000
Lead-202.....	10
Lead-203.....	1,000
Lead-205.....	100
Lead-209.....	1,000
Lead-210.....	0.01
Lead-211.....	100
Lead-212.....	1
Lead-214.....	100
Bismuth-200.....	1,000
Bismuth-201.....	1,000
Bismuth-202.....	1,000
Bismuth-203.....	100
Bismuth-205.....	100
Bismuth-206.....	100
Bismuth-207.....	10
Bismuth-210m.....	0.1
Bismuth-210.....	1
Bismuth-212.....	10
Bismuth-213.....	10
Bismuth-214.....	100
Polonium-203.....	1,000
Polonium-205.....	1,000
Polonium-207.....	1,000
Polonium-210.....	0.1
Astatine-207.....	100
Astatine-211.....	10
Radon-220.....	1
Radon-222.....	1
Francium-222.....	100
Francium-223.....	100
Radium-223.....	0.1
Radium-224.....	0.1
Radium-225.....	0.1
Radium-226.....	0.1
Radium-227.....	1,000
Radium-228.....	0.1
Actinium-224.....	1
Actinium-225.....	0.01
Actinium-226.....	0.1
Actinium-227.....	0.001
Actinium-228.....	1
Thorium-226.....	10
Thorium-227.....	0.01
Thorium-228.....	0.001
Thorium-229.....	0.001
Thorium-230.....	0.001
Thorium-231.....	100
Thorium-232.....	100
Thorium-234.....	10

APPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELING—Continued

Radionuclide	Quantity (μCi)
Thorium-natural	100
Protactinium-227	10
Protactinium-228	1
Protactinium-230	0.1
Protactinium-231	0.001
Protactinium-232	1
Protactinium-233	100
Protactinium-234	100
Uranium-230	0.01
Uranium-231	100
Uranium-232	0.001
Uranium-233	0.001
Uranium-234	0.001
Uranium-235	0.001
Uranium-236	0.001
Uranium-237	100
Uranium-238	100
Uranium-239	1,000
Uranium-240	100
Uranium-natural	100
Neptunium-232	100
Neptunium-233	1,000
Neptunium-234	100
Neptunium-235	100
Neptunium-236 (1.15x10 ⁶ y)	0.001
Neptunium-236 (22.5h)	1
Neptunium-237	1,001
Neptunium-238	10
Neptunium-239	100
Neptunium-240	1,000
Plutonium-234	10
Plutonium-235	1,000
Plutonium-236	0.001
Plutonium-237	100
Plutonium-238	0.001
Plutonium-239	0.001
Plutonium-240	0.001
Plutonium-241	0.01
Plutonium-242	0.001
Plutonium-243	1,000
Plutonium-244	0.001
Plutonium-245	100
Americium-237	1,000
Americium-238	100
Americium-239	1,000
Americium-240	100
Americium-241	0.001
Americium-242m	0.001
Americium-242	10
Americium-243	0.001
Americium-244m	100
Americium-244	10
Americium-245	1,000
Americium-246m	1,000
Americium-246	1,000
Curium-238	100
Curium-240	0.1
Curium-241	1
Curium-242	0.01

APPENDIX C TO §§ 20.1001—20.2401 QUANTITIES¹ OF LICENSED MATERIAL REQUIRING LABELING—Continued

Radionuclide	Quantity (μCi)
Curium-243	0.001
Curium-244	0.001
Curium-245	0.001
Curium-246	0.001
Curium-247	0.001
Curium-248	0.001
Curium-249	1,000
Berkelium-245	100
Berkelium-246	100
Berkelium-247	0.001
Berkelium-249	0.1
Berkelium-250	10
Californium-244	100
Californium-246	1
Californium-248	0.01
Californium-249	0.001
Californium-250	0.001
Californium-251	0.001
Californium-252	0.001
Californium-253	0.1
Californium-254	0.001
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	
Einsteium-250	0.001
Einsteium-251	100
Einsteium-253	0.1
Einsteium-254m	1
Einsteium-254	0.01
Fermium-252	1
Fermium-253	1
Fermium-254	10
Fermium-255	1
Fermium-257	0.01
Mendelevium-257	10
Mendelevium-258	0.01
Any radionuclide other than alpha emitting radionuclides not listed above, or mixtures of beta emitters of unknown composition	
	0.01

¹ The quantities listed above were derived by taking 1/10th of the most restrictive ALI listed in table 1, columns 1 and 2, of appendix B to §§ 20.1001-20.2401 of this part, rounding to the nearest factor of 10, and arbitrarily constraining the values listed between 0.001 and 1,000 μCi. Values of 100 μCi have been assigned for radionuclides having a radioactive half-life in excess of 10⁶ years (except rhenium, 1000 μCi) to take into account their low specific activity.

NOTE: For purposes of §§ 20.1902(e), 20.1905(a), and 20.2201(a) where there is involved a combination of radionuclides in known amounts, the limit for the combination should be derived as follows: determine, for each radionuclide in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific radionuclide when not in combination. The sum of such ratios for all radionuclides in the combination may not exceed "1" (i.e., "unity").

[56 FR 23465, May 21, 1991; 56 FR 61352, Dec. 3, 1991]

Appendix D to §§ 20.1001—20.2401—United States Nuclear Regulatory Commission Regional Offices

	Address	Telephone (24 hour)
Region I: Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.	USNRC, Region I, 475 Allendale Road, King of Prussia, PA 19406.	(215) 337-5000. (FTS) 346-5000.
Region II: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, Virginia, Virgin Islands, and West Virginia.	USNRC, Region II, 101 Manetta Street, NW, Suite 2900, Atlanta, GA 30323.	(404) 331-4503. (FTS) 841-4503.
Region III: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.	USNRC, Region III, 799 Roosevelt Road, Glen Ellyn, IL 60137.	(708) 790-5500. (FTS) 388-5500.
Region IV: Arkansas, Colorado, Idaho, Kansas, Louisiana, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming.	USNRC, Region IV, 611 Ryan Plaza Drive, Suite 1000, Arlington, TX 76011.	(817) 860-8100. (FTS) 728-8100.
Region IV: Field Office.	USNRC, Region IV, Uranium Recovery Field Office, 730 Simms Street, Suite 100a, Golden, CO 80401, Mail: P.O. Box 25325, Denver, CO 80225.	(303) 231-5800. (FTS) 554-2805.
Region V: Alaska, Arizona, California, Hawaii, Nevada, Oregon, Washington, and U.S. territories and possessions in the Pacific.	USNRC, Region V, 1450 Main Lane, Suite 210, Walnut Creek, CA 94596.	(510) 975-0200.

[56 FR 23468, May 21, 1991, as amended at 56 FR 41449, Aug. 21, 1991]

APPENDIX E to §§ 20.1001—20.2401—
[RESERVED]

receiver, provided all the required information is included. Copies of manifests required by this section may be legible carbon copies or legible photocopies.

APPENDIX F TO §§ 20.1001—20.2401—
REQUIREMENTS FOR LOW-LEVEL-
WASTE TRANSFER FOR DISPOSAL AT
LAND DISPOSAL FACILITIES AND MANI-
FESTS*I. Manifest*

The shipment manifest shall contain the name, address, and telephone number of the person generating the waste. The manifest shall also include the name, address, and telephone number or the name and EPA hazardous waste identification number of the person transporting the waste to the land disposal facility. The manifest must also indicate as completely as practicable: a physical description of the waste, the volume, radionuclide identity and quantity, the total radioactivity, and the principal chemical form. The solidification agent must be specified. Waste containing more than 0.1% chelating agents by weight must be identified and the weight percentage of the chelating agent estimated. Wastes classified as Class A, Class B, or Class C in § 61.55 of this chapter must be clearly identified as such in the manifest. The total quantity of the radionuclides ^3H , ^{14}C , ^{99}Tc , and ^{137}Cs must be shown. The manifest required by this paragraph may be shipping papers used to meet Department of Transportation or Environmental Protection Agency regulations or requirements of the

II. Certification

The waste generator shall include in the shipment manifest a certification that the transported materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the Commission. An authorized representative of the waste generator shall sign and date the manifest.

III. Control and Tracking

A. Any generating licensee who transfers radioactive waste to a land disposal facility or a licensed waste collector shall comply with the requirements in paragraphs A.1 through 8 of this section. Any generating licensee who transfers waste to a licensed waste processor who treats or repackages waste shall comply with the requirements of paragraphs A.4 through 8 of this section. A licensee shall:

1. Prepare all wastes so that the waste is classified according to § 61.55 of this chapter and meets the waste characteristics requirements in § 61.56 of this chapter;

2. Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with § 61.55 of this chapter;

3. Conduct a quality control program to ensure compliance with §§ 61.55 and 61.56 of

this chapter; the program must include management evaluation of audits;

4. Prepare shipping manifests to meet the requirements of sections I and II of this appendix;

5. Forward a copy of the manifest to the intended recipient, at the time of shipment, or deliver to a collector at the time the waste is collected, obtaining acknowledgment of receipt in the form of a signed copy of the manifest or equivalent documentation from the collector;

6. Include one copy of the manifest with the shipment;

7. Retain a copy of the manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by parts 30, 40, and 70 of this chapter; and

8. For any shipments or any part of a shipment for which acknowledgment of receipt has not been received within the times set forth in this section, conduct an investigation in accordance with paragraph E of this appendix.

B. Any waste collector licensee who handles only prepackaged waste shall:

1. Acknowledge receipt of the waste from the generator within 1 week of receipt by returning a signed copy of the manifest or equivalent documentation;

2. Prepare a new manifest to reflect consolidated shipments; the new manifest shall serve as a listing or index for the detailed generator manifests. Copies of the generator manifests shall be a part of the new manifest. The waste collector may prepare a new manifest without attaching the generator manifests, provided the new manifest contains for each package the information specified in section I of this appendix. The collector licensee shall certify that nothing has been done to the waste that would invalidate the generator's certification;

3. Forward a copy of the new manifest to the land disposal facility operator at the time of shipment;

4. Include the new manifest with the shipment to the disposal site;

5. Retain a copy of the manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by parts 30, 40, and 70 of this chapter, and retain information from generator manifest until disposition is authorized by the Commission; and

6. For any shipments or any part of a shipment for which acknowledgment of receipt is not received within the times set forth in this section, conduct an investigation in accordance with section III, E of this appendix.

C. Any licensed waste processor who treats or repackages wastes shall:

1. Acknowledge receipt of the waste from the generator within 1 week of receipt by

returning a signed copy of the manifest or equivalent documentation;

2. Prepare a new manifest that meets the requirements of sections I and II of this appendix. Preparation of the new manifest reflects that the processor is responsible for the waste;

3. Prepare all wastes so that the waste is classified according to § 61.55 of this chapter and meets the waste characteristics requirements in § 61.56 of this chapter;

4. Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with §§ 61.55 and 61.57 of this chapter;

5. Conduct a quality control program to ensure compliance with §§ 61.55 and 61.56 of this chapter. The program shall include management evaluation of audits;

6. Forward a copy of the new manifest to the disposal site operator or waste collector at the time of shipment, or deliver to a collector at the time the waste is collected, obtaining acknowledgment of receipt in the form of a signed copy of the manifest or equivalent documentation by the collector;

7. Include the new manifest with the shipment;

8. Retain copies of original manifests and new manifests and documentation of acknowledgment of receipt as the record of transfer of licensed material required by parts 30, 40, and 70 of this chapter; and

9. For any shipment or part of a shipment for which acknowledgment is not received within the times set forth in this section, conduct an investigation in accordance with section III, E of this appendix.

D. The land disposal facility operator shall:

1. Acknowledge receipt of the waste within 1 week of receipt by returning a signed copy of the manifest or equivalent documentation to the shipper. The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the operator. The returned copy of the manifest or equivalent documentation shall indicate any discrepancies between materials listed on the manifest and materials received;

2. Maintain copies of all completed manifests or equivalent documentation until the Commission authorizes their disposition; and

3. Notify the shipper (i.e., the generator, the collector, or processor) and the Administrator of the nearest Commission Regional Office listed in appendix D to this part when any shipment or part of a shipment has not arrived within 60 days after the advance manifest was received.

E. Any shipment or part of a shipment for which acknowledgment is not received within the times set forth in this section must:

1. Be investigated by the shipper if the shipper has not received notification or receipt within 20 days after transfer; and

2. Be traced and reported. The investigation shall include tracing the shipment and filing a report with the nearest Commission Regional Office listed in appendix D to this part. Each licensee who conducts a trace investigation shall file a written report with the appropriate NRC Regional Office within 2 weeks of completion of the investigation.

[56 FR 23468, May 21, 1991]

PART 21—REPORTING OF DEFECTS AND NONCOMPLIANCE

GENERAL PROVISIONS

Sec.

- 21.1 Purpose.
- 21.2 Scope.
- 21.3 Definitions.
- 21.4 Interpretations.
- 21.5 Communications.
- 21.6 Posting requirements.
- 21.7 Exemptions.
- 21.8 Information collection requirements: OMB approval.

NOTIFICATION

- 21.21 Notification of failure to comply or existence of a defect and its evaluation.

PROCUREMENT DOCUMENTS

- 21.31 Procurement documents.

INSPECTIONS, RECORDS

- 21.41 Inspections.
- 21.51 Maintenance of records.

ENFORCEMENT

- 21.61 Failure to notify.

AUTHORITY: Sec. 161, 68 Stat. 948, as amended, sec. 234, 83 Stat. 444, as amended (42 U.S.C. 2201, 2282); secs. 201, as amended, 206, 88 Stat. 1242, as amended, 1246 (42 U.S.C. 5841, 5846).

Sec. 21.2 also issued under secs. 135, 141, Pub. L. 97-425, 96 Stat. 2232, 2241 (42 U.S.C. 10155, 10161).

For the purposes of sec. 223, 68 Stat. 958, as amended (42 U.S.C. 2273); §§ 21.6, 21.21(a) and 21.31 are issued under sec. 161b, 68 Stat. 948, as amended (42 U.S.C. 2201(b)); and §§ 21.21, 21.41 and 21.51 are issued under sec. 161o, 68 Stat. 950, as amended (42 U.S.C. 2201(o)).

SOURCE: 42 FR 28893, June 6, 1977, unless otherwise noted.

GENERAL PROVISIONS

§ 21.1 Purpose.

The regulations in this part establish procedures and requirements for implementation of section 206 of the Energy Reorganization Act of 1974. That section requires any individual director or responsible officer of a firm constructing, owning, operating or supplying the components of any facility or activity which is licensed or otherwise regulated pursuant to the Atomic Energy Act of 1954, as amended, or the Energy Reorganization Act of 1974, who obtains information reasonably indicating: (a) That the facility, activity or basic component supplied to such facility or activity fails to comply with the Atomic Energy Act of 1954, as amended, or any applicable rule, regulation, order, or license of the Commission relating to substantial safety hazards or (b) that the facility, activity, or basic component supplied to such facility or activity contains defects, which could create a substantial safety hazard, to immediately notify the Commission of such failure to comply or such defect, unless he has actual knowledge that the Commission has been adequately informed of such defect or failure to comply.

§ 21.2 Scope.

(a) The regulations in this part apply, except as specifically provided otherwise in parts 31, 34, 35, 39, 40, 60, 61, 70, or part 72 of this chapter, to each individual, partnership, corporation, or other entity licensed pursuant to the regulations in this chapter to possess, use, or transfer within the United States source material, byproduct material, special nuclear material, and/or spent fuel and high level radioactive waste, or to construct, manufacture, possess, own, operate or transfer within the United States, any production or utilization facility or independent spent fuel storage installation (ISFSI) or monitored retrievable storage installation (MRS); and to each director and responsible officer of such a licensee. The regulations in this part apply also to each individual, corporation, partnership or other entity doing business within the United States, and

**10 CFR PART 61 Nuclear Regulatory Commission
Licensing Requirements for Land Disposal
of Radioactive Waste**

10 CFR Part 61
Nuclear Regulatory Commission
Licensing Requirements for Land Disposal of Radioactive Waste

Subpart A—General Provisions

Sec.

- 61.1 Purpose and scope.
- 61.2 Definitions.
- 61.3 License required.
- 61.4 Communications.
- 61.5 Interpretations.
- 61.6 Exemptions.
- 61.7 Concepts.
- 61.8 Reporting, recordkeeping, and application requirements: OMB approval not required.
- 61.9 Employee protection.
- 61.9a Completeness and accuracy of information.

Subpart B—Licenses

- 61.10 Content of application.
- 61.11 General information.
- 61.12 Specific technical information.
- 61.13 Technical analyses.

Sec.

- 61.14 Institutional information.
- 61.15 Financial information.
- 61.16 Other information.
- 61.20 Filing and distribution of application.
- 61.21 Elimination of repetition.
- 61.22 Updating of application.
- 61.23 Standards for issuance of a license.
- 61.24 Conditions of licenses.
- 61.25 Changes.
- 61.26 Amendment of license.
- 61.27 Application for renewal or closure.
- 61.28 Contents of application for closure.
- 61.29 Post-closure observation and maintenance.
- 61.30 Transfer of license.
- 61.31 Termination of license.

Subpart C—Performance Objectives

- 61.40 General requirement.
- 61.41 Protection of the general population from releases of radioactivity.
- 61.42 Protection of individuals from inadvertent intrusion.
- 61.43 Protection of individuals during operations.
- 61.44 Stability of the disposal site after closure.

Subpart D—Technical Requirements for Land Disposal Facilities

- 61.50 Disposal site suitability requirements for land disposal.
- 61.51 Disposal site design for land disposal.
- 61.52 Land disposal facility operation and disposal site closure.
- 61.53 Environmental monitoring.
- 61.54 Alternative requirements for design and operations.
- 61.55 Waste classification.
- 61.56 Waste characteristics.
- 61.57 Labeling.
- 61.58 Alternative requirements for waste classification and characteristics.
- 61.59 Institutional requirements.

Subpart E—Financial Assurances

- 61.61 Applicant qualifications and assurances.
- 61.62 Funding for disposal site closure and stabilization.
- 61.63 Financial assurances for institutional controls.

Subpart F—Participation by State Governments and Indian Tribes

- 61.70 Scope.
- 61.71 State and Tribal government consultation.
- 61.72 Filing of proposals for State and Tribal participation.
- 61.73 Commission approval of proposals.

Sec.

Subpart G—Records, Reports, Tests, and Inspections

- 61.80 Maintenance of records, reports, and transfers.
- 61.81 Tests at land disposal facilities.
- 61.82 Commission inspections of land disposal facilities.
- 61.83 Violations.

AUTHORITY: Secs. 53, 57, 62, 63, 65, 81, 161, 182, 183, 68 Stat. 930, 932, 933, 935, 948, 953, 954, as amended (42 U.S.C. 2073, 2077, 2092, 2093, 2095, 2111, 2201, 2232, 2233); secs. 202, 206, 88 Stat. 1244, 1246, (42 U.S.C. 5842, 5846); secs. 10 and 14, Pub. L. 95-601, 92 Stat. 2951 (42 U.S.C. 2021a and 5851).

For the purposes of sec. 223, 68 Stat. 958, as amended (42 U.S.C. 2273); Tables 1 and 2, §§ 61.3, 61.24, 61.25, 61.27(a), 61.41 through 61.43, 61.52, 61.53, 61.55, 61.56, and 61.61 through 61.63 are issued under sec. 161b, 68 Stat. 948, as amended (42 U.S.C. 2201(b)); §§ 61.9a, 61.10 through 61.16, 61.24 and 61.80 are issued under sec. 1610, 68 Stat. 950, as amended (42 U.S.C. 2201(o)).

SOURCE: 47 FR 57463, Dec. 27, 1982, unless otherwise noted.

Subpart A—General Provisions

§ 61.1 Purpose and scope.

(a) The regulations in this part establish, for land disposal of radioactive waste, the procedures, criteria, and terms and conditions upon which the Commission issues licenses for the disposal of radioactive wastes containing byproduct, source and special nuclear material received from other persons. Disposal of waste by an individual licensee is set forth in Part 20 of this chapter. Applicability of the requirements in this Part to Commission licenses for waste disposal facilities in effect on the effective date of this rule will be determined on a case-by-case basis and implemented through terms and conditions of the license or by orders issued by the Commission.

(b) Except as provided in Part 150 of this chapter, which addresses assumption of certain regulatory authority by Agreement States, and § 61.6 "Exemptions," the regulations in this part apply to all persons in the United States. The regulations in this part do not apply to (1) disposal of high-level waste as provided for in Part 60 of this chapter; (2) disposal of uranium or thorium tailings or wastes (byproduct

material as defined in § 40.4(a-1)) as provided for in Part 40 of this chapter in quantities greater than 10,000 kilograms and containing more than five (5) millicuries of radium-226; or (3) disposal of licensed material as provided for in Part 20 of this chapter.

§ 61.2 Definitions.

As used in this part:

"Active maintenance" means any significant remedial activity needed during the period of institutional control to maintain a reasonable assurance that the performance objectives in §§ 61.41 and 61.42 are met. Such active maintenance includes ongoing activities such as the pumping and treatment of water from a disposal unit or one-time measures such as replacement of a disposal unit cover. Active maintenance does not include custodial activities such as repair of fencing, repair or replacement of monitoring equipment, revegetation, minor additions to soil cover, minor repair of disposal unit covers, and general disposal site upkeep such as mowing grass.

"Buffer zone" is a portion of the disposal site that is controlled by the licensee and that lies under the disposal units and between the disposal units and the boundary of the site.

"Chelating agent" means amine polycarboxylic acids (e.g., EDTA, DTPA), hydroxy-carboxylic acids, and polycarboxylic acids (e.g., citric acid, carboxylic acid, and glucinic acid).

"Commencement of construction" means any clearing of land, excavation, or other substantial action that would adversely affect the environment of a land disposal facility. The term does not mean disposal site exploration, necessary roads for disposal site exploration, borings to determine foundation conditions, or other pre-construction monitoring or testing to establish background information related to the suitability of the disposal site or the protection of environmental values.

"Commission" means the Nuclear Regulatory Commission or its duly authorized representatives.

"Custodial Agency" means an agency of the government designated

to act on behalf of the government owner of the disposal site.

"Director" means the Director, Office of Nuclear Material Safety and Safeguards, U. S. Nuclear Regulatory Commission.

"Disposal" means the isolation of radioactive wastes from the biosphere inhabited by man and containing his food chains by emplacement in a land disposal facility.

"Disposal site" means that portion of a land disposal facility which is used for disposal of waste. It consists of disposal units and a buffer zone.

"Disposal unit" means a discrete portion of the disposal site into which waste is placed for disposal. For near-surface disposal the unit is usually a trench.

"Engineered barrier" means a man-made structure or device that is intended to improve the land disposal facility's ability to meet the performance objectives in Subpart C.

"Explosive material" means any chemical compound, mixture, or device, which produces a substantial instantaneous release of gas and heat spontaneously or by contact with sparks or flame.

"Government agency" means any executive department, commission, independent establishment, or corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States; or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the government.

"Hazardous waste" means those wastes designated as hazardous by Environmental Protection Agency regulations in 40 CFR Part 261.

"Hydrogeologic unit" means any soil or rock unit or zone which by virtue of its porosity or permeability, or lack thereof, has a distinct influence on the storage or movement of groundwater.

"Inadvertent intruder" means a person who might occupy the disposal site after closure and engage in normal activities, such as agriculture, dwelling construction, or other pursuits in which the person might be unknowingly exposed to radiation from the waste.

"Indian Tribe" means an Indian tribe as defined in the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450).

"Intruder barrier" means a sufficient depth of cover over the waste that inhibits contact with waste and helps to ensure that radiation exposures to an inadvertent intruder will meet the performance objectives set forth in this part, or engineered structures that provide equivalent protection to the inadvertent intruder.

"Land disposal facility" means the land, buildings, and equipment which is intended to be used for the disposal of radioactive wastes into the subsurface of the land. For purposes of this chapter, a geologic repository as defined in Part 60 is not considered a land disposal facility.

"License" means a license issued under the regulations in Part 61 of this chapter. "Licensee" means the holder of such a license.

"Monitoring" means observing and making measurements to provide data to evaluate the performance and characteristics of the disposal site.

"Near-surface disposal facility" means a land disposal facility in which radioactive waste is disposed of in or within the upper 30 meters of the earth's surface.

"Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, government agency other than the Commission or the Department of Energy (except that the Department of Energy is considered a person within the meaning of the regulations in this part to the extent that its facilities and activities are subject to the licensing and related regulatory authority of the Commission pursuant to law), any State or any political subdivision of or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent, or agency of the foregoing.

"Pyrophoric liquid" means any liquid that ignites spontaneously in dry or moist air at or below 130°F (54.5°C). A pyrophoric solid is any solid material, other than one classed

as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials.

"Site closure and stabilization" means those actions that are taken upon completion of operations that prepare the disposal site for custodial care and that assure that the disposal site will remain stable and will not need ongoing active maintenance.

"State" means any State, Territory, or possession of the United States, Puerto Rico, and the District of Columbia.

"Stability" means structural stability.

"Surveillance" means observation of the disposal site for purposes of visual detection of need for maintenance, custodial care, evidence of intrusion, and compliance with other license and regulatory requirements.

"Tribal Governing Body" means a Tribal organization as defined in the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450).

"Waste" means those low-level radioactive wastes containing source, special nuclear, or byproduct material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level waste has the same meaning as in the Low-Level Waste Policy Act, that is, radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste).

[47 FR 57463, Dec. 27, 1982, as amended at 54 FR 22583, May 25, 1989]

§ 61.3 License required.

(a) No person may receive, possess, and dispose of radioactive waste containing source, special nuclear, or byproduct material at a land disposal facility unless authorized by a license issued by the Commission pursuant to this part, or unless exemption has

been granted by the Commission under § 61.6 of this part.

(b) Each person shall file an application with the Commission and obtain a license as provided in this part before commencing construction of a land disposal facility. Failure to comply with this requirement may be grounds for denial of a license.

§ 61.4 Communications.

Except where otherwise specified, all communications and reports concerning the regulations in this part and applications filed under them should be addressed to the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555. Communications, reports, and applications may be delivered in person at the Commission's Offices at 2120 L Street NW, Washington, DC, or 11555 Rockville Pike, Rockville, Maryland.

[53 FR 4111, Feb. 12, 1988, as amended at 53 FR 43421, Oct. 27, 1988]

§ 61.5 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be considered binding upon the Commission.

§ 61.6 Exemptions.

The Commission may, upon application by any interested person, or upon its own initiative, grant any exemption from the requirements of the regulations in this part as it determines is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest.

§ 61.7 Concepts.

(a) *The disposal facility.* (1) Part 61 is intended to apply to land disposal of radioactive waste and not to other methods such as sea or extraterrestrial disposal. Part 61 contains procedural requirements and performance objectives applicable to any method of land disposal. It contains specific technical requirements for near-surface

disposal of radioactive waste which involves disposal in the uppermost portion of the earth, approximately 30 meters. Burial deeper than 30 meters may also be satisfactory. Technical requirements for alternative methods will be added in the future.

(2) Near-surface disposal of radioactive waste takes place at a near-surface disposal facility, which includes all of the land and buildings necessary to carry out the disposal. The disposal site is that portion of the facility which is used for disposal of waste and consists of disposal units and a buffer zone. A disposal unit is a discrete portion of the disposal site into which waste is placed for disposal. For near-surface disposal, the disposal unit is usually a trench. A buffer zone is a portion of the disposal site that is controlled by the licensee and that lies under the site and between the boundary of the disposal site and any disposal unit. It provides controlled space to establish monitoring locations which are intended to provide an early warning of radionuclide movement, and to take mitigative measures if needed. In choosing a disposal site, site characteristics should be considered in terms of the indefinite future and evaluated for at least a 500 year time frame.

(b) *Waste classification and near-surface disposal.* (1) Disposal of radioactive waste in near-surface disposal facilities has the following safety objectives: protection of the general population from releases of radioactivity, protection of individuals from inadvertent intrusion, and protection of individuals during operations. A fourth objective is to ensure stability of the site after closure.

(2) A cornerstone of the system is stability—stability of the waste and the disposal site so that once emplaced and covered, the access of water to the waste can be minimized. Migration of radionuclides is thus minimized, long-term active maintenance can be avoided, and potential exposures to intruders reduced. While stability is a desirable characteristic for all waste much radioactive waste does not contain sufficient amounts of radionuclides to be of great concern from these standpoints; this waste, however, tends to be unstable, such as ordinary trash

type wastes. If mixed with the higher activity waste, their deterioration could lead to failure of the system and permit water to penetrate the disposal unit and cause problems with the higher activity waste. Therefore, in order to avoid placing requirements for a stable waste form on relatively innocuous waste, these wastes have been classed as Class A waste. The Class A waste will be disposed of in separate disposal units at the disposal site. However, Class A waste that is stable may be mixed with other classes of waste. Those higher activity wastes that should be stable for proper disposal are classed as Class B and C waste. To the extent that it is practicable, Class B and C waste forms or containers should be designed to be stable, i.e., maintain gross physical properties and identity, over 300 years. For certain radionuclides prone to migration, a maximum disposal site inventory based on the characteristics of the disposal site may be established to limit potential exposure.

(3) It is possible but unlikely that persons might occupy the site in the future and engage in normal pursuits without knowing that they were receiving radiation exposure. These persons are referred to as inadvertent intruders. Protection of such intruders can involve two principal controls: institutional control over the site after operations by the site owner to ensure that no such occupation or improper use of the site occurs; or, designating which waste could present an unacceptable risk to an intruder, and disposing of this waste in a manner that provides some form of intruder barrier that is intended to prevent contact with the waste. This regulation incorporates both types of protective controls.

(4) Institutional control of access to the site is required for up to 100 years. This permits the disposal of Class A and Class B waste without special provisions for intrusion protection, since these classes of waste contain types and quantities of radioisotopes that will decay during the 100-year period and will present an acceptable hazard to an intruder. The government landowner administering the active institutional control program has flexibility

in controlling site access which may include allowing productive uses of the land provided the integrity and long-term performance of the site are not affected.

(5) Waste that will not decay to levels which present an acceptable hazard to an intruder within 100 years is designated as Class C waste. This waste is disposed of at a greater depth than the other classes of waste so that subsequent surface activities by an intruder will not disturb the waste. Where site conditions prevent deeper disposal, intruder barriers such as concrete covers may be used. The effective life of these intruder barriers should be 500 years. A maximum concentration of radionuclides is specified for all wastes so that at the end of the 500 year period, remaining radioactivity will be at a level that does not pose an unacceptable hazard to an intruder or public health and safety. Waste with concentrations above these limits is generally unacceptable for near-surface disposal. There may be some instances where waste with concentrations greater than permitted for Class C would be acceptable for near-surface disposal with special processing or design. These will be evaluated on a case-by-case basis. Class C waste must also be stable.

(c) *The licensing process.* (1) During the preoperational phase, the potential applicant goes through a process of disposal site selection by selecting a region of interest, examining a number of possible disposal sites within the area of interest and narrowing the choice to the proposed site. Through a detailed investigation of the disposal site characteristics the potential applicant obtains data on which to base an analysis of the disposal site's suitability. Along with these data and analyses, the applicant submits other more general information to the Commission in the form of an application for a license for land disposal. The Commission's review of the application is in accordance with administrative procedures established by rule and may involve participation by affected State governments or Indian tribes. While the proposed disposal site must be owned by a State or the Federal government before the

Commission will issue a license, it may be privately owned during the preoperational phase if suitable arrangements have been made with a State or the Federal government to take ownership in fee of the land before the license is issued.

(2) During the operational phase, the licensee carries out disposal activities in accordance with the requirements of this regulation and any conditions on the license. Periodically, the authority to conduct the above ground operations and dispose of waste will be subject to a license renewal, at which time the operating history will be reviewed and a decision made to permit or deny continued operation. When disposal operations are to cease, the licensee applies for an amendment to his license to permit site closure. After final review of the licensee's site closure and stabilization plan, the Commission may approve the final activities necessary to prepare the disposal site so that ongoing active maintenance of the site is not required during the period of institutional control.

(3) During the period when the final site closure and stabilization activities are being carried out, the licensee is in a disposal site closure phase. Following that, for a period of 5 years, the licensee must remain at the disposal site for a period of post-closure observation and maintenance to assure that the disposal site is stable and ready for institutional control. The Commission may approve shorter or require longer periods if conditions warrant. At the end of this period, the licensee applies for a license transfer to the disposal site owner.

(4) After a finding of satisfactory disposal site closure, the Commission will transfer the license to the State or Federal government that owns the disposal site. If the Department of Energy is the Federal agency administering the land on behalf of the Federal government the license will be terminated because the Commission lacks regulatory authority over the Department for this activity. Under the conditions of the transferred license, the owner will carry out a program of monitoring to assure continued satisfactory disposal site performance,

physical surveillance to restrict access to the site and carry out minor custodial activities. During this period, productive uses of the land might be permitted if those uses do not affect the stability of the site and its ability to meet the performance objectives. At the end of the prescribed period of institutional control, the license will be terminated by the Commission.

§ 61.8 Reporting, recordkeeping, and application requirements: OMB approval not required.

The information collection requirements contained in this part affect fewer than ten persons. Therefore, under section 3506(c)(5) of the Paperwork Reduction Act of 1980 (Pub. L. 96-511), OMB clearance is not required for these information collection requirements.

§ 61.9 Employee protection.

(a) Discrimination by a Commission licensee, an applicant for a Commission licensee, or a contractor or subcontractor of a Commission licensee or applicant against an employee for engaging in certain protected activities is prohibited. Discrimination includes discharge and other actions that relate to compensation, terms, conditions, and privileges of employment. The protected activities are established in section 210 of the Energy Reorganization Act of 1974, as amended, and in general are related to the administration or enforcement of a requirement imposed under the Atomic Energy Act or the Energy Reorganization Act.

(1) The protected activities include but are not limited to:

(i) Providing the Commission information about possible violations of requirements imposed under either of the above statutes;

(ii) Requesting the Commission to institute action against his or her employer for the administration or enforcement of these requirements; or

(iii) Testifying in any Commission proceeding.

(2) These activities are protected even if no formal proceeding is actually initiated as a result of the employee assistance or participation.

(3) This section has no application to any employee alleging discrimination prohibited by this section who, acting without direction from his or her employer (or the employer's agent), deliberately causes a violation of any requirement of the Energy Reorganization Act of 1974, as amended, or the Atomic Energy Act of 1954, as amended.

(b) Any employee who believes that he or she has been discharged or otherwise discriminated against by any person for engaging in the protected activities specified in paragraph (a)(1) of this section may seek a remedy for the discharge or discrimination through an administrative proceeding in the Department of Labor. The administrative proceeding must be initiated within 30 days after an alleged violation occurs by filing a complaint alleging the violation with the Department of Labor, Employment Standards Administration, Wage and Hour Division. The Department of Labor may order reinstatement, back pay, and compensatory damages.

(c) A violation of paragraph (a) of this section by a Commission licensee, an applicant for a Commission licensee, or a contractor or subcontractor of a Commission licensee or applicant may be grounds for:

(1) Denial, revocation, or suspension of the license.

(2) Imposition of a civil penalty on the licensee or applicant.

(3) Other enforcement action.

(d) Actions taken by an employer, or others, which adversely affect an employee may be predicated upon nondiscriminatory grounds. The prohibition applies when the adverse action occurs because the employee has engaged in protected activities. An employee's engagement in protected activities does not automatically render him or her immune from discharge or discipline for legitimate reasons or from adverse action dictated by non-prohibited considerations.

(e) Each licensee and each applicant shall post Form NRC-3, "Notice to Employees," on its premises. Posting must be at locations sufficient to permit employees protected by this section to observe a copy on the way to or from their place of work. Prem-

ises must be posted not later than 30 days after an application is docketed and remain posted while the application is pending before the Commission, during the term of the license, and for 30 days following license termination.

NOTE: Copies of Form NRC-3 may be obtained by writing to the Regional Administrator of the appropriate U.S. Nuclear Regulatory Commission Regional Office listed in Appendix D, Part 20 of this chapter.

[47 FR 57463, Dec. 27, 1982, as amended at 52 FR 31612, Aug. 21, 1987]

§ 61.9a Completeness and accuracy of information.

(a) Information provided to the Commission by an applicant for a license or by a licensee or information required by statute or by the Commission's regulations, orders, or license conditions to be maintained by the applicant or the licensee shall be complete and accurate in all material respects.

(b) Each applicant or licensee shall notify the Commission of information identified by the applicant or licensee as having for the regulated activity a significant implication for public health and safety or common defense and security. An applicant or licensee violates this paragraph only if the applicant or licensee fails to notify the Commission of information that the applicant or licensee has identified as having a significant implication for public health and safety or common defense and security. Notification shall be provided to the Administrator of the appropriate Regional Office within two working days of identifying the information. This requirement is not applicable to information which is already required to be provided to the Commission by other reporting or updating requirements.

[52 FR 49372, Dec. 31, 1987]

Subpart B—Licenses

§ 61.10 Content of application.

An application to receive from others, possess and dispose of wastes containing or contaminated with source, byproduct or special nuclear

material by land disposal must consist of general information, specific technical information, institutional information, and financial information as set forth in §§ 61.11 through 61.16. An environmental report prepared in accordance with Subpart A of Part 51 of this chapter must accompany the application.

[49 FR 9405, Mar. 12, 1984]

§ 61.11 General information.

The general information must include each of the following:

(a) Identity of the applicant including:

(1) The full name, address, telephone number and description of the business or occupation of the applicant;

(2) If the applicant is a partnership, the name, and address of each partner and the principal location where the partnership does business;

(3) If the applicant is a corporation or an unincorporated association, (i) the state where it is incorporated or organized and the principal location where it does business, and (ii) the names and addresses of its directors and principal officers; and

(4) If the applicant is acting as an agent or representative of another person in filing the application, all information required under this paragraph must be supplied with respect to the other person.

(b) Qualifications of the applicant:

(1) The organizational structure of the applicant, both offsite and onsite, including a description of lines of authority and assignments of responsibilities, whether in the form of administrative directives, contract provisions, or otherwise;

(2) The technical qualifications, including training and experience, of the applicant and members of the applicant's staff to engage in the proposed activities. Minimum training and experience requirements for personnel filling key positions described in paragraph (b)(1) of this section must be provided;

(3) A description of the applicant's personnel training program; and

(4) The plan to maintain an adequate complement of trained personnel to carry out waste receipt, han-

dling, and disposal operations in a safe manner.

(c) A description of:

(1) The location of the proposed disposal site;

(2) The general character of the proposed activities;

(3) The types and quantities of radioactive waste to be received, possessed, and disposed of;

(4) Plans for use of the land disposal facility for purposes other than disposal of radioactive wastes; and

(5) The proposed facilities and equipment.

(d) Proposed schedules for construction, receipt of waste, and first emplacement of waste at the proposed land disposal facility.

§ 61.12 Specific technical information.

The specific technical information must include the following information needed for demonstration that the performance objectives of Subpart C of this part and the applicable technical requirements of Subpart D of this part will be met:

(a) A description of the natural and demographic disposal site characteristics as determined by disposal site selection and characterization activities. The description must include geologic, geotechnical, hydrologic, meteorologic, climatologic, and biotic features of the disposal site and vicinity.

(b) A description of the design features of the land disposal facility and the disposal units. For near-surface disposal, the description must include those design features related to infiltration of water; integrity of covers for disposal units; structural stability of backfill, wastes, and covers; contact of wastes with standing water; disposal site drainage; disposal site closure and stabilization; elimination to the extent practicable of long-term disposal site maintenance; inadvertent intrusion; occupational exposures; disposal site monitoring; and adequacy of the size of the buffer zone for monitoring and potential mitigative measures.

(c) A description of the principal design criteria and their relationship to the performance objectives.

(d) A description of the design basis natural events or phenomena and

their relationship to the principal design criteria.

(e) A description of codes and standards which the applicant has applied to the design and which will apply to construction of the land disposal facilities.

(f) A description of the construction and operation of the land disposal facility. The description must include as a minimum the methods of construction of disposal units; waste emplacement; the procedures for and areas of waste segregation; types of intruder barriers; onsite traffic and drainage systems; survey control program; methods and areas of waste storage; and methods to control surface water and groundwater access to the wastes. The description must also include a description of the methods to be employed in the handling and disposal of wastes containing chelating agents or other non-radiological substances that might affect meeting the performance objectives in Subpart C of this part.

(g) A description of the disposal site closure plan, including those design features which are intended to facilitate disposal site closure and to eliminate the need for ongoing active maintenance.

(h) An identification of the known natural resources at the disposal site, the exploitation of which could result in inadvertent intrusion into the low-level wastes after removal of active institutional control.

(i) A description of the kind, amount, classification and specifications of the radioactive material proposed to be received, possessed, and disposed of at the land disposal facility.

(j) A description of the quality control program for the determination of natural disposal site characteristics and for quality control, during the design, construction, operation and closure of the land disposal facility and the receipt, handling, and emplacement of waste. Audits and managerial controls must be included.

(k) A description of the radiation safety program for control and monitoring of radioactive effluents to ensure compliance with the performance objective in § 61.41 of this part and occupational radiation exposure

to ensure compliance with the requirements of Part 20 of this chapter and to control contamination of personnel, vehicles, equipment, buildings, and the disposal site. Both routine operations and accidents must be addressed. The program description must include procedures, instrumentation, facilities, and equipment.

(l) A description of the environmental monitoring program to provide data to evaluate potential health and environmental impacts and the plan for taking corrective measures if migration of radionuclides is indicated.

(m) A description of the administrative procedures that the applicant will apply to control activities at the land disposal facility.

§ 61.13 Technical analyses.

The specific technical information must also include the following analyses needed to demonstrate that the performance objectives of Subpart C of this part will be met:

(a) Pathways analyzed in demonstrating protection of the general population from releases of radioactivity must include air, soil, groundwater, surface water, plant uptake, and exhalation by burrowing animals. The analyses must clearly identify and differentiate between the roles performed by the natural disposal site characteristics and design features in isolating and segregating the wastes. The analyses must clearly demonstrate that there is reasonable assurance that the exposure to humans from the release of radioactivity will not exceed the limits set forth in § 61.41.

(b) Analyses of the protection of individuals from inadvertent intrusion must include demonstration that there is reasonable assurance the waste classification and segregation requirements will be met and that adequate barriers to inadvertent intrusion will be provided.

(c) Analyses of the protection of individuals during operations must include assessments of expected exposures due to routine operations and likely accidents during handling, storage, and disposal of waste. The analyses must provide reasonable assurance

that exposures will be controlled to meet the requirements of Part 20 of this chapter.

(d) Analyses of the long-term stability of the disposal site and the need for ongoing active maintenance after closure must be based upon analyses of active natural processes such as erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils, and surface drainage of the disposal site. The analyses must provide reasonable assurance that there will not be a need for ongoing active maintenance of the disposal site following closure.

§ 61.14 Institutional information.

The institutional information must include:

(a) A certification by the Federal or State government which owns the disposal site that the Federal or State government is prepared to accept transfer of the license when the provisions of § 61.30 are met, and will assume responsibility for custodial care after site closure and postclosure observation and maintenance.

(b) Where the proposed disposal site is on land not owned by the Federal or a State government, the applicant must submit evidence that arrangements have been made for assumption of ownership in fee by the Federal or a State government before the Commission issues a license.

§ 61.15 Financial information.

The financial information must be sufficient to demonstrate that the financial qualifications of the applicant are adequate to carry out the activities for which the license is sought and meet other financial assurance requirements as specified in Subpart E of this part.

§ 61.16 Other information.

Depending upon the nature of the wastes to be disposed of, and the design and proposed operation of the land disposal facility, additional information may be requested by the Commission including the following:

(a) Physical security measures, if appropriate. Any application to receive and possess special nuclear material in

quantities subject to the requirements of Part 73 of this chapter shall demonstrate how the physical security requirements of Part 73 will be met. In determining whether receipt and possession will be subject to the requirements of Part 73, the applicant shall not consider the quantity of special nuclear material that has been disposed of.

(b) Safety information concerning criticality, if appropriate.

(1) Any application to receive and possess special nuclear material in quantities that would be subject to the requirements of § 70.24, "Criticality accident requirements" of Part 70 of this chapter shall demonstrate how the requirements of that section will be met, unless the applicant requests an exemption pursuant to § 70.24(d). In determining whether receipt and possession would be subject to the requirements of § 70.24, the applicant shall not consider the quantity of special nuclear material that has been disposed of.

(2) Any application to receive and possess special nuclear material shall describe proposed procedures for avoiding accidental criticality, which address both storage of special nuclear material prior to disposal and waste emplacement for disposal.

§ 61.20 Filing and distribution of application.

(a) An application for a license under this part, and any amendments thereto, shall be filed with the Director, must be signed by the applicant or the applicant's authorized representative under oath, and must consist of 1 signed original and 2 copies.

(b) Another 85 copies of the application must be retained by the applicant for distribution in accordance with written instructions from the Director or designee.

(c) *Fees.* Application, amendment, and inspection fees applicable to a license covering the receipt and disposal of radioactive wastes in a land disposal facility are required by Part 170 of this chapter.

[47 FR 57463, Dec. 27, 1982, as amended at 49 FR 9405, Mar. 12, 1984]

§ 61.21

§ 61.21 Elimination of repetition.

In its application, the applicant may incorporate by reference information contained in previous applications, statements, or reports filed with the Commission if these references are clear and specific.

[49 FR 9405, Mar. 12, 1984]

§ 61.22 Updating of application.

(a) The application must be as complete as possible in the light of information that is available at the time of submittal.

(b) The applicant shall supplement its application in a timely manner, as necessary, to permit the Commission to review, prior to issuance of a license, any changes in the activities proposed to be carried out or new information regarding the proposed activities.

[49 FR 9405, Mar. 12, 1984]

§ 61.23 Standards for issuance of a license.

A license for the receipt, possession, and disposal of waste containing or contaminated with source, special nuclear, or byproduct material will be issued by the Commission upon finding that the issuance of the license will not be inimical to the common defense and security and will not constitute an unreasonable risk to the health and safety of the public, and:

(a) The applicant is qualified by reason of training and experience to carry out the disposal operations requested in a manner that protects health and minimizes danger to life or property.

(b) The applicant's proposed disposal site, disposal design, land disposal facility operations (including equipment, facilities, and procedures), disposal site closure, and postclosure institutional control are adequate to protect the public health and safety in that they provide reasonable assurance that the general population will be protected from releases of radioactivity as specified in the performance objective in § 61.41, Protection of the general population from releases of radioactivity.

(c) The applicant's proposed disposal site, disposal site design, land disposal

10 CFR Ch. I (1-1-90 Edition)

facility operations (including equipment, facilities, and procedures), disposal site closure, and postclosure institutional control are adequate to protect the public health and safety in that they will provide reasonable assurance that individual inadvertent intruders are protected in accordance with the performance objective in § 61.42, Protection of individuals from inadvertent intrusion.

(d) The applicant's proposed land disposal facility operations, including equipment, facilities, and procedures, are adequate to protect the public health and safety in that they will provide reasonable assurance that the standards for radiation protection set out in Part 20 of this chapter will be met.

(e) The applicant's proposed disposal site, disposal site design, land disposal facility operations, disposal site closure, and postclosure institutional control are adequate to protect the public health and safety in that they will provide reasonable assurance that long-term stability of the disposed waste and the disposal site will be achieved and will eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure.

(f) The applicant's demonstration provides reasonable assurance that the applicable technical requirements of Subpart D of this part will be met.

(g) The applicant's proposal for institutional control provides reasonable assurance that institutional control will be provided for the length of time found necessary to ensure the findings in paragraphs (b) through (e) of this section and that the institutional control meets the requirements of § 61.59, Institutional requirements.

(h) The information on financial assurances meets the requirements of Subpart E of this part.

(i) The applicant's physical security information provides reasonable assurance that the requirements of Part 73 of this chapter will be met, insofar as they are applicable to special nuclear material to be possessed before disposal under the license.

(j) The applicant's criticality safety procedures are adequate to protect the public health and safety and provide

reasonable assurance that the requirements of § 70.24, Criticality accident requirements, of Part 70 of this chapter will be met, insofar as they are applicable to special nuclear material to be possessed before disposal under the license.

(k) Any additional information submitted as requested by the Commission pursuant to § 61.16, Other information, is adequate.

(l) The requirements of Subpart A of Part 51 of this chapter have been met.

[47 FR 57463, Dec. 27, 1982, as amended at 49 FR 9405, Mar. 12, 1984]

§ 61.24 Conditions of licenses.

(a) A license issued under this part, or any right thereunder, may be transferred, assigned, or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of the license to any person, only if the Commission finds, after securing full information, that the transfer is in accordance with the provisions of the Atomic Energy Act and gives its consent in writing in the form of a license amendment.

(b) The licensee shall submit written statements under oath upon request of the Commission, at any time before termination of the license, to enable the Commission to determine whether or not the license should be modified, suspended, or revoked.

(c) The license will be transferred to the site owner only on the full implementation of the final closure plan as approved by the Commission, including post-closure observation and maintenance.

(d) The licensee shall be subject to the provisions of the Atomic Energy Act now or hereafter in effect, and to all rules, regulations, and orders of the Commission. The terms and conditions of the license are subject to amendment, revision, or modification, by reason of amendments to, or by reason of rules, regulations, and orders issued in accordance with the terms of the Atomic Energy Act.

(e) Any license may be revoked, suspended or modified in whole or in part for any material false statement in the application or any statement of fact required under Section 182 of the Act, or because of conditions revealed by

any application or statement of fact or any report, record, or inspection or other means which would warrant the Commission to refuse to grant a license to the original application, or for failure to operate the facility in accordance with the terms of the license, or for any violation of, or failure to observe any of the terms and conditions of the Act, or any rule, regulation, license or order of the Commission.

(f) Each person licensed by the Commission pursuant to the regulations in this part shall confine possession and use of materials to the locations and purposes authorized in the license.

(g) No radioactive waste may be disposed of until the Commission has inspected the land disposal facility and has found it to be in conformance with the description, design, and construction described in the application for a license.

(h) The Commission may incorporate in any license at the time of issuance, or thereafter, by appropriate rule, regulation or order, additional requirements and conditions with respect to the licensee's receipt, possession, and disposal of source, special nuclear or byproduct material as it deems appropriate or necessary in order to:

(1) Promote the common defense and security;

(2) Protect health or to minimize danger to life or property;

(3) Require reports and the keeping of records, and to provide for inspections of activities under the license that may be necessary or appropriate to effectuate the purposes of the Act and regulations thereunder.

(i) Any licensee who receives and possesses special nuclear material under this part in quantities that would be subject to the requirements of § 70.24 of Part 70 of this chapter shall comply with the requirements of that section. The licensee shall not consider the quantity of special nuclear material that has been disposed of.

(j) The authority to dispose of wastes expires on the date stated in the license except as provided in § 61.27(a) of this part.

(k)(1) Each licensee shall notify the appropriate NRC Regional Administrator, in writing, immediately follow-

§ 61.25

ing the filing of a voluntary or involuntary petition for bankruptcy under any Chapter of Title 11 (Bankruptcy) of the United States Code by or against:

- (i) The licensee;
 - (ii) An entity (as that term is defined in 11 U.S.C. 101(14)) controlling the licensee or listing the license or licensee as property of the estate; or
 - (iii) An affiliate (as that term is defined in 11 U.S.C. 101(2)) of the licensee.
- (2) This notification must indicate:
- (i) The bankruptcy court in which the petition for bankruptcy was filed; and
 - (ii) The date of the filing of the petition.

[47 FR 57463, Dec. 27, 1982, as amended at 52 FR 1295, Jan. 12, 1987]

§ 61.25 Changes.

(a) Except as provided for in specific license conditions, the licensee shall not make changes in the land disposal facility or procedures described in the license application. The license will include conditions restricting subsequent changes to the facility and the procedures authorized which are important to public health and safety. These license restrictions will fall into three categories of descending importance to public health and safety as follows: (1) those features and procedures which may not be changed without (i) 60 days' prior notice to the Commission, (ii) 30 days notice of opportunity for a prior hearing, and (iii) prior Commission approval; (2) those features and procedures which may not be changed without (i) 60 days prior notice to the Commission, and (ii) prior Commission approval; and (3) those features and procedures which may not be changed without 60 days prior notice to the Commission. Features and procedures falling in paragraph (a)(3) of this section may not be changed without prior Commission approval if the Commission, after having received the required notice, so orders.

(b) Amendments authorizing site closure, license transfer, or license termination shall be included in paragraph (a)(1) of this section.

(c) The Commission shall provide a copy of the notice for opportunity for

10 CFR Ch. I (1-1-90 Edition)

hearings provided in paragraph (a)(1) of this section to State and local officials or tribal governing bodies specified in § 2.104(e) of Part 2 of this chapter.

§ 61.26 Amendment of license.

(a) An application for amendment of a license must be filed in accordance with § 61.20 and shall fully describe the changes desired.

(b) In determining whether an amendment to a license will be approved, the Commission will apply the criteria set forth in § 61.23.

§ 61.27 Application for renewal or closure.

(a) Any expiration date on a license applies only to the above ground activities and to the authority to dispose of waste. Failure to renew the license shall not relieve the licensee of responsibility for carrying out site closure, postclosure observation and transfer of the license to the site owner. An application for renewal or an application for closure under § 61.28 must be filed at least 30 days prior to license expiration.

(b) Applications for renewal of a license must be filed in accordance with §§ 61.10 through 61.16 and § 61.20. Applications for closure must be filed in accordance with §§ 61.20 and 61.28. Information contained in previous applications, statements or reports filed with the Commission under the license may be incorporated by reference if the references are clear and specific.

(c) In any case in which a licensee has timely filed an application for renewal of a license, the license for continued receipt and disposal of licensed materials does not expire until the Commission has taken final action on the application for renewal.

(d) In determining whether a license will be renewed, the Commission will apply the criteria set forth in § 61.23.

§ 61.28 Contents of application for closure.

(a) Prior to final closure of the disposal site, or as otherwise directed by the Commission, the applicant shall submit an application to amend the license for closure. This closure applica-

tion must include a final revision and specific details of the disposal site closure plan included as part of the license application submitted under § 61.12(g) that includes each of the following:

(1) Any additional geologic, hydrologic, or other disposal site data pertinent to the long-term containment of emplaced radioactive wastes obtained during the operational period.

(2) The results of tests, experiments, or any other analyses relating to backfill of excavated areas, closure and sealing, waste migration and interaction with emplacement media, or any other tests, experiments, or analysis pertinent to the long-term containment of emplaced waste within the disposal site.

(3) Any proposed revision of plans for:

(i) Decontamination and/or dismantlement of surface facilities;

(ii) Backfilling of excavated areas; or

(iii) Stabilization of the disposal site for post-closure care.

(b) An environmental report or a supplement to an environmental report prepared in accordance with Subpart A of Part 51 of this chapter must accompany the application.

(c) Upon review and consideration of an application to amend the license for closure submitted in accordance with paragraph (a) of this section, the Commission shall issue an amendment authorizing closure if there is reasonable assurance that the long-term performance objectives of Subpart C of this part will be met.

[47 FR 57463, Dec. 27, 1982, as amended at 49 FR 9406, Mar. 12, 1984]

§ 61.29 Post-closure observation and maintenance.

Following completion of closure authorized in § 61.28, the licensee shall observe, monitor, and carry out necessary maintenance and repairs at the disposal site until the license is transferred by the Commission in accordance with § 61.30. Responsibility for the disposal site must be maintained by the licensee for 5 years. A shorter or longer time period for post-closure observation and maintenance may be established and approved as part of

the site closure plan, based on site-specific conditions.

§ 61.30 Transfer of license.

(a) Following closure and the period of post-closure observation and maintenance, the licensee may apply for an amendment to transfer the license to the disposal site owner. The license shall be transferred when the Commission finds:

(1) That the closure of the disposal site has been made in conformance with the licensee's disposal site closure plan, as amended and approved as part of the license;

(2) That reasonable assurance has been provided by the licensee that the performance objectives of Subpart C of this part are met;

(3) That any funds and necessary records for care will be transferred to the disposal site owner;

(4) That the post-closure monitoring program is operational for implementation by the disposal site owner; and

(5) That the Federal or State government agency which will assume responsibility for institutional control of the disposal site is prepared to assume responsibility and ensure that the institutional requirements found necessary under § 61.23(g) will be met.

§ 61.31 Termination of license.

(a) Following any period of institutional control needed to meet the requirements found necessary under § 61.23, the licensee may apply for an amendment to terminate the license.

(b) This application must be filed, and will be reviewed, in accordance with the provision of § 61.20 and of this section.

(c) A license is terminated only when the Commission finds:

(1) That the institutional control requirements found necessary under § 61.23(g) have been met; and

(2) That any additional requirements resulting from new information developed during the institutional control period have been met, and that permanent monuments or markers warning against intrusion have been installed.

Subpart C—Performance Objectives

§ 61.40 General requirement.

Land disposal facilities must be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to humans are within the limits established in the performance objectives in §§ 61.41 through 61.44.

§ 61.41 Protection of the general population from releases of radioactivity.

Concentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable.

§ 61.42 Protection of individuals from inadvertent intrusion.

Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed.

§ 61.43 Protection of individuals during operations.

Operations at the land disposal facility must be conducted in compliance with the standards for radiation protection set out in Part 20 of this chapter, except for releases of radioactivity in effluents from the land disposal facility, which shall be governed by § 61.41 of this part. Every reasonable effort shall be made to maintain radiation exposures as low as is reasonably achievable.

§ 61.44 Stability of the disposal site after closure.

The disposal facility must be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the

extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required.

Subpart D—Technical Requirements for Land Disposal Facilities

§ 61.50 Disposal site suitability requirements for land disposal.

(a) Disposal site suitability for near-surface disposal.

(1) The purpose of this section is to specify the minimum characteristics a disposal site must have to be acceptable for use as a near-surface disposal facility. The primary emphasis in disposal site suitability is given to isolation of wastes, a matter having long-term impacts, and to disposal site features that ensure that the long-term performance objectives of Subpart C of this part are met, as opposed to short-term convenience or benefits.

(2) The disposal site shall be capable of being characterized, modeled, analyzed and monitored.

(3) Within the region or state where the facility is to be located, a disposal site should be selected so that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of Subpart C of this part.

(4) Areas must be avoided having known natural resources which, if exploited, would result in failure to meet the performance objectives of Subpart C of this part.

(5) The disposal site must be generally well drained and free of areas of flooding or frequent ponding. Waste disposal shall not take place in a 100-year flood plain, coastal high-hazard area or wetland, as defined in Executive Order 11988, "Floodplain Management Guidelines."

(6) Upstream drainage areas must be minimized to decrease the amount of runoff which could erode or inundate waste disposal units.

(7) The disposal site must provide sufficient depth to the water table that ground water intrusion, perennial or otherwise, into the waste will not occur. The Commission will consider

an exception to this requirement to allow disposal below the water table if it can be conclusively shown that disposal site characteristics will result in molecular diffusion being the predominant means of radionuclide movement and the rate of movement will result in the performance objectives of Subpart C of this part being met. In no case will waste disposal be permitted in the zone of fluctuation of the water table.

(8) The hydrogeologic unit used for disposal shall not discharge ground water to the surface within the disposal site.

(9) Areas must be avoided where tectonic processes such as faulting, folding, seismic activity, or vulcanism may occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of Subpart C of this part, or may preclude defensible modeling and prediction of long-term impacts.

(10) Areas must be avoided where surface geologic processes such as mass wasting, erosion, slumping, landsliding, or weathering occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of Subpart C of this part, or may preclude defensible modeling and prediction of long-term impacts.

(11) The disposal site must not be located where nearby facilities or activities could adversely impact the ability of the site to meet the performance objectives of Subpart C of this part or significantly mask the environmental monitoring program.

(b) Disposal site suitability requirements for land disposal other than near-surface (reserved).

§ 61.51 Disposal site design for land disposal.

(a) Disposal site design for near-surface disposal.

(1) Site design features must be directed toward long-term isolation and avoidance of the need for continuing active maintenance after site closure.

(2) The disposal site design and operation must be compatible with the disposal site closure and stabilization plan and lead to disposal site closure

that provides reasonable assurance that the performance objectives of Subpart C of this part will be met.

(3) The disposal site must be designed to complement and improve, where appropriate, the ability of the disposal site's natural characteristics to assure that the performance objectives of Subpart C of this part will be met.

(4) Covers must be designed to minimize to the extent practicable water infiltration, to direct percolating or surface water away from the disposed waste, and to resist degradation by surface geologic processes and biotic activity.

(5) Surface features must direct surface water drainage away from disposal units at velocities and gradients which will not result in erosion that will require ongoing active maintenance in the future.

(6) The disposal site must be designed to minimize to the extent practicable the contact of water with waste during storage, the contact of standing water with waste during disposal, and the contact of percolating or standing water with wastes after disposal.

(b) Disposal site design for other than near-surface disposal (reserved).

§ 61.52 Land disposal facility operation and disposal site closure.

(a) Near-surface disposal facility operation and disposal site closure.

(1) Wastes designated as Class A pursuant to § 61.55, must be segregated from other wastes by placing in disposal units which are sufficiently separated from disposal units for the other waste classes so that any interaction between Class A wastes and other wastes will not result in the failure to meet the performance objectives in Subpart C of this Part. This segregation is not necessary for Class A wastes if they meet the stability requirements in § 61.56(b) of this part.

(2) Wastes designated as Class C pursuant to § 61.55, must be disposed of so that the top of the waste is a minimum of 5 meters below the top surface of the cover or must be disposed of with intruder barriers that are designed to protect against an in-

§ 61.53

10 CFR Ch. I (1-1-90 Edition)

advertent intrusion for at least 500 years.

(3) All wastes shall be disposed of in accordance with the requirements of paragraphs (a)(4) through (11) of this section.

(4) Wastes must be emplaced in a manner that maintains the package integrity during emplacement, minimizes the void spaces between packages, and permits the void spaces to be filled.

(5) Void spaces between waste packages must be filled with earth or other material to reduce future subsidence within the fill.

(6) Waste must be placed and covered in a manner that limits the radiation dose rate at the surface of the cover to levels that at a minimum will permit the licensee to comply with all provisions of § 20.105 of this chapter at the time the license is transferred pursuant to § 61.30 of this part.

(7) The boundaries and locations of each disposal unit (e.g., trenches) must be accurately located and mapped by means of a land survey. Near-surface disposal units must be marked in such a way that the boundaries of each unit can be easily defined. Three permanent survey marker control points, referenced to United States Geological Survey (USGS) or National Geodetic Survey (NGS) survey control stations, must be established on the site to facilitate surveys. The USGS or NGS control stations must provide horizontal and vertical controls as checked against USGS or NGS record files.

(8) A buffer zone of land must be maintained between any buried waste and the disposal site boundary and beneath the disposed waste. The buffer zone shall be of adequate dimensions to carry out environmental monitoring activities specified in § 61.53(d) of this part and take mitigative measures if needed.

(9) Closure and stabilization measures as set forth in the approved site closure plan must be carried out as each disposal unit (e.g., each trench) is filled and covered.

(10) Active waste disposal operations must not have an adverse effect on completed closure and stabilization measures.

(11) Only wastes containing or contaminated with radioactive materials shall be disposed of at the disposal site.

(b) Facility operation and disposal site closure for land disposal facilities other than near-surface (reserved).

§ 61.53 Environmental monitoring.

(a) At the time a license application is submitted, the applicant shall have conducted a preoperational monitoring program to provide basic environmental data on the disposal site characteristics. The applicant shall obtain information about the ecology, meteorology, climate, hydrology, geology, geochemistry, and seismology of the disposal site. For those characteristics that are subject to seasonal variation, data must cover at least a twelve month period.

(b) The licensee must have plans for taking corrective measures if migration of radionuclides would indicate that the performance objectives of Subpart C may not be met.

(c) During the land disposal facility site construction and operation, the licensee shall maintain a monitoring program. Measurements and observations must be made and recorded to provide data to evaluate the potential health and environmental impacts during both the construction and the operation of the facility and to enable the evaluation of long-term effects and the need for mitigative measures. The monitoring system must be capable of providing early warning of releases of radionuclides from the disposal site before they leave the site boundary.

(d) After the disposal site is closed, the licensee responsible for post-operational surveillance of the disposal site shall maintain a monitoring system based on the operating history and the closure and stabilization of the disposal site. The monitoring system must be capable of providing early warning of releases of radionuclides from the disposal site before they leave the site boundary.

§ 61.54 Alternative requirements for design and operations.

The Commission may, upon request or on its own initiative, authorize provisions other than those set forth in §§ 61.51 through 61.53 for the segregation and disposal of waste and for the design and operation of a land disposal facility on a specific basis, if it finds reasonable assurance of compliance with the performance objectives of Subpart C of this part.

§ 61.55 Waste classification.

(a) Classification of waste for near surface disposal.

(1) *Considerations.* Determination of the classification of radioactive waste involves two considerations. First, consideration must be given to the concentration of long-lived radionuclides (and their shorter-lived precursors) whose potential hazard will persist long after such precautions as institutional controls, improved waste form, and deeper disposal have ceased to be effective. These precautions delay the time when long-lived radionuclides could cause exposures. In addition, the magnitude of the potential dose is limited by the concentration and availability of the radionuclide at the time of exposure. Second, consideration must be given to the concentration of shorter-lived radionuclides for which requirements on institutional controls, waste form, and disposal methods are effective.

(2) *Classes of waste.* (i) Class A waste is waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics of Class A waste must meet the minimum requirements set forth in § 61.56(a). If Class A waste also meets the stability requirements set forth in § 61.56(b), it is not necessary to segregate the waste for disposal.

(ii) Class B waste is waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in § 61.56.

(iii) Class C waste is waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional meas-

ures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in § 61.56.

(iv) Waste that is not generally acceptable for near-surface disposal is waste for which form and disposal methods must be different, and in general more stringent, than those specified for Class C waste. In the absence of specific requirements in this part, such waste must be disposed of in a geologic repository as defined in Part 60 of this chapter unless proposals for disposal of such waste in a disposal site licensed pursuant to this part are approved by the Commission.

(3) Classification determined by long-lived radionuclides. If radioactive waste contains only radionuclides listed in Table 1, classification shall be determined as follows:

(i) If the concentration does not exceed 0.1 times the value in Table 1, the waste is Class A.

(ii) If the concentration exceeds 0.1 times the value in Table 1 but does not exceed the value in Table 1, the waste is Class C.

(iii) If the concentration exceeds the value in Table 1, the waste is not generally acceptable for near-surface disposal.

(iv) For wastes containing mixtures of radionuclides listed in Table 1, the total concentration shall be determined by the sum of fractions rule described in paragraph (a)(7) of this section.

TABLE 1

Radionuclide	Concentration curies per cubic meter
C-14.....	8
C-14 in activated metal.....	80
Ni-59 in activated metal.....	220
Nb-94 in activated metal.....	0.2
Tc-99.....	3
I-129.....	0.08
Alpha emitting transuranic nuclides with half-life greater than five years.....	¹ 100
Pu-241.....	¹ 3,500
Cm-242.....	¹ 20,000

¹ Units are nanocuries per gram.

(4) Classification determined by short-lived radionuclides. If radioactive waste does not contain any of the radionuclides listed in Table 1, classification shall be determined based on the concentrations shown in Table 2. However, as specified in paragraph (a)(6) of this section, if radioactive waste does not contain any nuclides listed in either Table 1 or 2, it is Class A.

(i) If the concentration does not exceed the value in Column 1, the waste is Class A.

(ii) If the concentration exceeds the value in Column 1, but does not exceed the value in Column 2, the waste is Class B.

(iii) If the concentration exceeds the value in Column 2, but does not exceed the value in Column 3, the waste is Class C.

(iv) If the concentration exceeds the value in Column 3, the waste is not generally acceptable for near-surface disposal.

(v) For wastes containing mixtures of the nuclides listed in Table 2, the total concentration shall be determined by the sum of fractions rule described in paragraph (a)(7) of this section.

TABLE 2

Radionuclide	Concentration, curies per cubic meter		
	Col. 1	Col. 2	Col. 3
Total of all nuclides with less than 5 year half life.....	700	(¹)	(¹)
H-3.....	40	(¹)	(¹)
Co-60.....	700	(¹)	(¹)
Ni-63.....	3.5	70	700
Ni-63 in activated metal.....	35	700	7000
Sr-90.....	0.04	150	7000
Cs-137.....	1	44	4600

¹ There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other nuclides in Table 2 determine the waste to the Class C independent of these nuclides.

(5) Classification determined by both long- and short-lived radionuclides. If radioactive waste contains a mixture of radionuclides, some of which are listed in Table 1, and some of which are listed in Table 2, classification shall be determined as follows:

(i) If the concentration of a nuclide listed in Table 1 does not exceed 0.1 times the value listed in Table 1, the class shall be that determined by the concentration of nuclides listed in Table 2.

(ii) If the concentration of a nuclide listed in Table 1 exceeds 0.1 times the value listed in Table 1 but does not exceed the value in Table 1, the waste shall be Class C; provided the concentration of nuclides listed in Table 2 does not exceed the value shown in Column 3 of Table 2.

(6) Classification of wastes with radionuclides other than those listed in Tables 1 and 2. If radioactive waste does not contain any nuclides listed in either Table 1 or 2, it is Class A.

(7) The sum of the fractions rule for mixtures of radionuclides. For determining classification for waste that contains a mixture of radionuclides, it is necessary to determine the sum of fractions by dividing each nuclide's concentration by the appropriate limit and adding the resulting values. The appropriate limits must all be taken from the same column of the same table. The sum of the fractions for the column must be less than 1.0 if the waste class is to be determined by that column. Example: A waste contains Sr-90 in a concentration of 50 Ci/m³ and Cs-137 in a concentration of 22 Ci/m³. Since the concentrations both exceed the values in Column 1, Table 2, they must be compared to Column 2 values. For Sr-90 fraction 50/150=0.33; for Cs-137 fraction, 22/44=0.5; the sum of the fractions=0.83. Since the sum is less than 1.0, the waste is Class B.

(8) *Determination of concentrations in wastes.* The concentration of a radionuclide may be determined by indirect methods such as use of scaling factors which relate the inferred concentration of one radionuclide to another that is measured, or radionuclide material accountability, if there is reasonable assurance that the indirect methods can be correlated with actual measurements. The concentration of a radionuclide may be averaged over the volume of the waste, or weight of the waste if the units are expressed as nanocuries per gram.

[47 FR 57463, Dec. 27, 1982, as amended at 54 FR 22583, May 25, 1989]

§ 61.56 Waste characteristics.

(a) The following requirements are minimum requirements for all classes of waste and are intended to facilitate handling at the disposal site and provide protection of health and safety of personnel at the disposal site.

(1) Waste must not be packaged for disposal in cardboard or fiberboard boxes.

(2) Liquid waste must be solidified or packaged in sufficient absorbent material to absorb twice the volume of the liquid.

(3) Solid waste containing liquid shall contain as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume.

(4) Waste must not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.

(5) Waste must not contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. This does not apply to radioactive gaseous waste packaged in accordance with paragraph (a)(7) of this section.

(6) Waste must not be pyrophoric. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable.

(7) Waste in a gaseous form must be packaged at a pressure that does not exceed 1.5 atmospheres at 20°C. Total activity must not exceed 100 curies per container.

(8) Waste containing hazardous, biological, pathogenic, or infectious material must be treated to reduce to the maximum extent practicable the potential hazard from the non-radiological materials.

(b) The requirements in this section are intended to provide stability of the waste. Stability is intended to ensure that the waste does not structurally degrade and affect overall stability of the site through slumping, collapse, or other failure of the disposal unit and thereby lead to water infiltration. Stability is also a factor in limiting expo-

sure to an inadvertent intruder, since it provides a recognizable and nondispersible waste.

(1) Waste must have structural stability. A structurally stable waste form will generally maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, and microbial activity, and internal factors such as radiation effects and chemical changes. Structural stability can be provided by the waste form itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.

(2) Notwithstanding the provisions in § 61.56(a) (2) and (3), liquid wastes, or wastes containing liquid, must be converted into a form that contains as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5% of the volume of the waste for waste processed to a stable form.

(3) Void spaces within the waste and between the waste and its package must be reduced to the extent practicable.

§ 61.57 Labeling.

Each package of waste must be clearly labeled to identify whether it is Class A waste, Class B waste, or class C waste, in accordance with § 61.55.

§ 61.58 Alternative requirements for waste classification and characteristics.

The Commission may, upon request or on its own initiative, authorize other provisions for the classification and characteristics of waste on a specific basis, if, after evaluation, of the specific characteristics of the waste, disposal site, and method of disposal, it finds reasonable assurance of compliance with the performance objectives in Subpart C of this part.

§ 61.59 Institutional requirements.

(a) *Land ownership.* Disposal of radioactive waste received from other persons may be permitted only on land

owned in fee by the Federal or a State government.

(b) *Institutional control.* The land owner or custodial agency shall carry out an institutional control program to physically control access to the disposal site following transfer of control of the disposal site from the disposal site operator. The institutional control program must also include, but not be limited to, carrying out an environmental monitoring program at the disposal site, periodic surveillance, minor custodial care, and other requirements as determined by the Commission; and administration of funds to cover the costs for these activities. The period of institutional controls will be determined by the Commission, but institutional controls may not be relied upon for more than 100 years following transfer of control of the disposal site to the owner.

Subpart E—Financial Assurances

§ 61.61 Applicant qualifications and assurances.

Each applicant shall show that it either possesses the necessary funds or has reasonable assurance of obtaining the necessary funds, or by a combination of the two, to cover the estimated costs of conducting all licensed activities over the planned operating life of the project, including costs of construction and disposal.

§ 61.62 Funding for disposal site closure and stabilization.

(a) The applicant shall provide assurance that sufficient funds will be available to carry out disposal site closure and stabilization, including: (1) Decontamination or dismantlement of land disposal facility structures; and (2) closure and stabilization of the disposal site so that following transfer of the disposal site to the site owner, the need for ongoing active maintenance is eliminated to the extent practicable and only minor custodial care, surveillance, and monitoring are required. These assurances shall be based on Commission-approved cost estimates reflecting the Commission-approved plan for disposal site closure and stabilization. The applicant's cost estimates must take into account total capital

costs that would be incurred if an independent contractor were hired to perform the closure and stabilization work.

(b) In order to avoid unnecessary duplication and expense, the Commission will accept financial sureties that have been consolidated with earmarked financial or surety arrangements established to meet requirements of other Federal or State agencies and/or local governing bodies for such decontamination, closure and stabilization. The Commission will accept this arrangement only if they are considered adequate to satisfy these requirements and that the portion of the surety which covers the closure of the disposal site is clearly identified and committed for use in accomplishing these activities.

(c) The licensee's surety mechanism will be annually reviewed by the Commission to assure that sufficient funds are available for completion of the closure plan, assuming that the work has to be performed by an independent contractor.

(d) The amount of surety liability should change in accordance with the predicted cost of future closure and stabilization. Factors affecting closure and stabilization cost estimates include: inflation; increases in the amount of disturbed land; changes in engineering plans; closure and stabilization that has already been accomplished and any other conditions affecting costs. This will yield a surety that is at least sufficient at all times to cover the costs of closure of the disposal units that are expected to be used before the next license renewal.

(e) The term of the surety mechanism must be open ended unless it can be demonstrated that another arrangement would provide an equivalent level of assurance. This assurance could be provided with a surety mechanism which is written for a specified period of time (e.g., five years) yet which must be automatically renewed unless the party who issues the surety notifies the Commission and the beneficiary (the site owner) and the principal (the licensee) not less than 90 days prior to the renewal date of its intention not to renew. In such a situation the licensee must submit a replace-

ment surety within 30 days after notification of cancellation. If the licensee fails to provide a replacement surety acceptable to the Commission, the site owner may collect on the original surety.

(f) Proof of forfeiture must not be necessary to collect the surety so that in the event that the licensee could not provide an acceptable replacement surety within the required time, the surety shall be automatically collected prior to its expiration. The conditions described above would have to be clearly stated on any surety instrument which is not open-ended, and must be agreed to by all parties. Liability under the surety mechanism must remain in effect until the closure and stabilization program has been completed and approved by the Commission and the license has been transferred to the site owner.

(g) Financial surety arrangements generally acceptable to the Commission include: surety bonds, cash deposits, certificates of deposits, deposits of government securities, escrow accounts, irrevocable letters or lines of credit, trust funds, and combinations of the above or such other types of arrangements as may be approved by the Commission. However, self-insurance, or any arrangement which essentially constitutes pledging the assets of the licensee, will not satisfy the surety requirement for private sector applicants since this provides no additional assurance other than that which already exists through license requirements.

§ 61.63 Financial assurances for institutional controls.

(a) Prior to the issuance of the license, the applicant shall provide for Commission review and approval a copy of a binding arrangement, such as a lease, between the applicant and the disposal site owner that ensures that sufficient funds will be available to cover the costs of monitoring and any required maintenance during the institutional control period. The binding arrangement will be reviewed periodically by the Commission to ensure that changes in inflation, technology and disposal facility operations are reflected in the arrangements.

(b) Subsequent changes to the binding arrangement specified in paragraph (a) of this section relevant to institutional control shall be submitted to the Commission for approval.

Subpart F—Participation by State Governments and Indian Tribes

§ 61.70 Scope.

This subpart describes mechanisms through which the Commission will implement a formal request from a State or tribal government to participate in the review of a license application for a land disposal facility. Nothing in this subpart may be construed to bar the State or tribal governing body from participating in subsequent Commission proceedings concerning the license application as provided under Federal law and regulations.

§ 61.71 State and Tribal government consultation.

Upon request of a State or tribal governing body, the Director shall make available Commission staff to discuss with representatives of the State or tribal governing body information submitted by the applicant, applicable Commission regulations, licensing procedures, potential schedules, and the type and scope of State activities in the license review permitted by law. In addition, staff shall be made available to consult and cooperate with the State or tribal governing body in developing proposals for participation in the license review.

§ 61.72 Filing of proposals for State and Tribal participation.

(a) A State or tribal governing body whose interest is affected by a near-surface disposal facility at the proposed site may submit to the Director a proposal for participation in the review of a license application. Proposals must be submitted within the following time periods:

(1) For the State in which the disposal facility will be located, or any State that is member of an interstate compact that includes the State in which the disposal facility is located, no later than 45 days following publication in the FEDERAL REGISTER of the

notice of tendering of an application submitted under § 61.20.

(2) For any other State, or for a tribal governing body, no later than 120 days following publication in the FEDERAL REGISTER of the notice of tendering of an application submitted under § 61.20.

(b) Proposals for participation in the licensing process must be made in writing and must be signed by the Governor of the State or the official otherwise provided for by State or tribal law.

(c) At a minimum, proposals must contain each of the following items of information:

(1) A general description of how the State or tribe wishes to participate in the licensing process specifically identifying those issues it wishes to review.

(2) A description of material and information which the State or tribe plans to submit to the Commission for consideration in the licensing process. A tentative schedule referencing steps in the review and calendar dates for planned submittals should be included.

(3) A description of any work that the State or tribe proposes to perform for the Commission in support of the licensing process.

(4) A description of State or tribal plans to facilitate local government and citizen participation.

(5) A preliminary estimate of the types and extent of impacts which the State expects, should a disposal facility be located as proposed.

(6) If desired, any requests for educational or information services (seminars, public meetings) or other actions from the Commission such as establishment of additional Public Document Rooms or exchange of State personnel under the Intergovernmental Personnel Act.

§ 61.73 Commission approval of proposals.

(a) Upon receipt of a proposal submitted in accordance with § 61.72, the Director shall arrange for a meeting between the representatives of the State or tribal governing body and the Commission staff to discuss the proposal and to ensure full and effective participation by the State or tribe in the Commission's license review.

(b) If requested by a State or tribal governing body, the Director may approve all or any part of a proposal if the Director determines that:

(1) The proposed activities are within the scope of Commission statutory responsibility and the type and magnitude of impacts which the State or tribe may bear are sufficient to justify their participation; and

(2) The proposed activities will contribute productively to the licensing review.

(c) The decision of the Director will be transmitted in writing to the governor or the designated official of the tribal governing body.

(d) Participation by a State or Indian tribe shall not affect their rights to participate in an adjudicatory hearing as provided by Part 2 of this chapter.

Subpart G—Records, Reports, Tests, and Inspections

§ 61.80 Maintenance of records, reports, and transfers.

(a) Each licensee shall maintain any records and make any reports in connection with the licensed activities as may be required by the conditions of the license or by the rules, regulations, and orders of the Commission.

(b) Records which are required by the regulations in this part or by license conditions must be maintained for a period specified by the appropriate regulations in this chapter or by license condition. If a retention period is not otherwise specified, these records must be maintained and transferred to the officials specified in paragraph (e) of this section as a condition of license termination unless the Commission otherwise authorizes their disposition.

(c) Records which must be maintained pursuant to this part may be the original or a reproduced copy or a microform if this reproduced copy or microform is capable of producing copy that is clear and legible at the end of the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required re-

tention period. Records such as letters, drawings, specifications, must include all pertinent information such as stamps, initials, and signatures. The licensee shall maintain adequate safeguards against tampering with and loss of records.

(d) If there is a conflict between the Commission's regulations in this part, license condition, or other written Commission approval or authorization pertaining to the retention period for the same type of record, the longest retention period specified takes precedence.

(e) Notwithstanding paragraphs (a) through (d) of this section, the licensee shall record the location and the quantity of radioactive wastes contained in the disposal site and transfer these records upon license termination to the chief executive of the nearest municipality, the chief executive of the county in which the facility is located, the county zoning board or land development and planning agency, the State governor and other State, local, and Federal governmental agencies as designated by the Commission at the time of license termination.

(f) Following receipt and acceptance of a shipment of radioactive waste, the licensee shall record the date of disposal of the waste, the location in the disposal site, the condition of the waste packages as received, any discrepancies between materials listed on the manifest and those received, and any evidence of leaking or damaged packages or radiation or contamination levels in excess of limits specified in Department of Transportation and Commission regulations. The licensee shall briefly describe any repackaging operations of any of the waste packages included in the shipment, plus any other information required by the Commission as a license condition. The licensee shall retain these records until the Commission transfers or terminates the license that authorizes the activities described in this section.

(g) Each licensee shall comply with the safeguards reporting requirements of §§ 30.55, 40.64, 70.53 and 70.54 of this chapter if the quantities or activities of materials received or transferred exceed the limits of these sections. Inventory reports required by

these sections are not required for materials after disposal.

(h) Each licensee authorized to dispose of radioactive waste received from other persons shall file a copy of its financial report or a certified financial statement annually with the Commission in order to update the information base for determining financial qualifications.

(i)(1) Each licensee authorized to dispose of waste materials received from other persons, pursuant to this part, shall submit annual reports to the appropriate Commission regional office shown in Appendix D of Part 20 of this chapter, with copies to the Director, Division of High-Level Waste Management, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C., 20555. Reports shall be submitted by the end of the first calendar quarter of each year for the preceding year.

(2) The reports shall include (i) specification of the quantity of each of the principal radionuclides released to unrestricted areas in liquid and in airborne effluents during the preceding year, (ii) the results of the environmental monitoring program, (iii) a summary of licensee disposal unit survey and maintenance activities, (iv) a summary, by waste class, of activities and quantities of radionuclides disposed of, (v) any instances in which observed site characteristics were significantly different from those described in the application for a license; and (vi) any other information the Commission may require. If the quantities of radioactive materials released during the reporting period, monitoring results, or maintenance performed are significantly different from those expected in the materials previously reviewed as part of the licensing action, the report must cover this specifically.

(j) Each licensee shall report in accordance with the requirements of § 70.52 of this chapter.

(k) Any transfer of byproduct source, and special nuclear material by the licensee is subject to the requirements in §§ 30.41, 40.51, and 70.41 of this chapter. Byproduct, source and special nuclear material means materi

als as defined in these parts, respectively.

(47 FR 57463, Dec. 27, 1982, as amended at 52 FR 31612, Aug. 21, 1987; 53 FR 19251, May 27, 1988)

§ 61.81 Tests at land disposal facilities.

(a) Each licensee shall perform, or permit the Commission to perform, any tests as the Commission deems appropriate or necessary for the administration of the regulations in this part, including tests of:

(1) Radioactive wastes and facilities used for the receipt, storage, treatment, handling and disposal of radioactive wastes.

(2) Radiation detection and monitoring instruments; and

(3) Other equipment and devices used in connection with the receipt, possession, handling, treatment, storage, or disposal of radioactive waste.

§ 61.82 Commission inspections of land disposal facilities.

(a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect radioactive waste not yet disposed of, and the premises, equipment, operations, and facilities in which radioactive wastes are received, possessed, handled, treated, stored, or disposed of.

(b) Each licensee shall make available to the Commission for inspection, upon reasonable notice, records kept by it pursuant to the regulations in this chapter. Authorized representatives of the Commission may copy and take away copies of, for the Commission's use, any record required to be kept pursuant to this part.

§ 61.83 Violations.

An injunction or other court order may be obtained prohibiting any violation of any provision of the Atomic Energy Act of 1954, as amended, or any regulation or order issued thereunder. A court order may be obtained for the payment of a civil penalty imposed pursuant to section 234 of the Act for violation of section 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Act, or section 206 of the Energy Reorganization Act of 1974, or any rule.

PART 62—CRITERIA AND PROCEDURES FOR EMERGENCY ACCESS TO NON-FEDERAL AND REGIONAL LOW-LEVEL WASTE DISPOSAL FACILITIES

Subpart A—General Provisions

Sec.

62.1 Purpose and scope.

62.2 Definitions.

62.3 Communications.

62.4 Interpretations.

62.5 Specific exemptions.

62.8 Information collection requirements: OMB approval.

Subpart B—Request for a Commission Determination

62.11 Filing and distribution of a determination request.

62.12 Contents of a request for emergency access: General information.

62.13 Contents of a request for emergency access: Alternatives.

62.14 Contents of a request for an extension of emergency access.

62.15 Additional information.

62.16 Withdrawal of a determination request.

62.17 Elimination of repetition.

62.18 Denial of request.

Subpart C—Issuance of a Commission Determination

62.21 Determination for granting emergency access.

62.22 Notice of issuance of a determination.

62.23 Determination for granting temporary emergency access.

62.24 Extension of emergency access.

62.25 Criteria for a Commission determination.

62.26 Criteria for designating a disposal facility.

Subpart D—Termination of Emergency Access

62.31 Termination of emergency access.

AUTHORITY: Secs. 81, 161, as amended, 68 Stat. 935, 948, 949, 950, 951, as amended. (42 U.S.C. 2111, 2201); secs. 201, 209, as amended, 88 Stat. 1242, 1248, as amended (42 U.S.C. 5841, 5849); secs. 3, 4, 5, 6, 99 Stat. 1843, 1844, 1845, 1846, 1847, 1848, 1849, 1850, 1851, 1852, 1853, 1854, 1855, 1856, 1857. (42 U.S.C. 2021c, 2021d, 2021e, 2021f).

SOURCE: 54 FR 5420, Feb. 3, 1989, unless otherwise noted.

